

APPENDIX A
RÉSUMÉ

M. SAM MANNAN, PhD, PE, CSP

*Regents Professor of Chemical Engineering
T. Michael O'Connor Chair I and Professor
Chemical Engineering Department
Texas A&M University
College Station, TX 77843-3122
Phone: (979) 862-3985
Fax: (979) 845-6446
e-mail: mannan@tamu.edu*

*Director
Mary Kay O'Connor Process Safety Center
Texas A&M University System
College Station, TX 77843-3122
Phone: (979) 862-3985
Fax: (979) 458-1493
e-mail: mannan@tamu.edu
URL: <http://process-safety.tamu.edu>*

EDUCATION

Ph.D., 1986, Chemical Engineering, University of Oklahoma, Norman, Oklahoma.

M.S., 1983, Chemical Engineering, University of Oklahoma, Norman, Oklahoma.

B.S., 1978, Chemical Engineering, University of Engineering and Technology, Dhaka, Bangladesh.

POSITIONS HELD

Regents Professor of Chemical Engineering, Texas A&M University System, 2008-todate

Professor of Chemical Engineering and Director of the Mary Kay O'Connor Process Safety Center, Texas A&M University, September 2001-todate.

Associate Professor of Chemical Engineering and Director of the Mary Kay O'Connor Process Safety Center, Texas A&M University, August 1997-August 2001.

Vice President, RMT, Inc., Austin, Texas; June 1994 - July 1997.

Division Director, RMT, Inc., Austin, Texas; February 1990 - May 1994.

Assistant Professor; School of Chemical Engineering and Materials Science, University of Oklahoma, Norman, Oklahoma; March, 1986 - February, 1990.

Graduate Research Assistant; School of Chemical Engineering and Materials Science, University of Oklahoma, Norman, Oklahoma; August, 1981 - February, 1986.

Chemical Engineer; Department of Pollution Control, Ministry of Municipalities, Agedabia, Libya; May, 1980 - July, 1981.

Chemical Engineer; Power and Desalination Plant, Zweitina, Libya; July, 1978 - April, 1980.

Resume for M. Sam Mannan, PhD, PE, CSP

Engineer; Engineering Department, Bangladesh Development Bank, Dhaka, Bangladesh; March, 1978 - June, 1978.

REGISTRATIONS/CERTIFICATIONS

Professional Engineer, Texas, No. 68339

Professional Engineer, Louisiana, No. 24388

Certified Safety Professional, No. 12534

PROFESSIONAL AFFILIATIONS

American Institute of Chemical Engineers

American Society of Safety Engineers

International Institute of Ammonia Refrigeration

National Fire Protection Association

Society for Risk Analysis

OTHER ACHIEVEMENTS

Written and Oral Testimony on “Preventing Chemical Terrorism: Building a Foundation of Security at our Nation’s Chemical Facilities,” before the Subcommittee on Cybersecurity, Infrastructure Protection and Security Technologies for the House Committee on Homeland Security, United States House of Representatives, Washington, DC, February 11, 2011.

Chemical Engineering Advisory Board, Worcester Polytechnic Institute, 2010-2013.

Written Testimony on the “U.S. Department of Homeland Security’s Reauthorization of Chemical Facility Anti-Terrorism Standards,” before the Homeland Security and Governmental Affairs Committee, United States Senate, Washington, DC, March 3, 2010.

Member, Presidential Council on Climate and Diversity, Texas A&M University, 2009-

Norton H. Walton/Russell L. Miller Award in Safety/Loss Prevention, American Institute of Chemical Engineers, 2009.

Medal of Honor, Technical University of Lodz, Poland, December 2008.

Editorial Advisory Board, Encyclopedia of Chemical Processing, 2008-.

Written and Oral Testimony on the “U.S. Department of Homeland Security’s Chemical Facility Anti-Terrorism Act of 2008,” before the Subcommittee on Transportation Security and Infrastructure Protection of the Committee on Homeland Security, United States House of Representatives, Washington, DC, December 12, 2007.

Fellow, American Institute of Chemical Engineers, 2007-

Senator, The Faculty Senate, Texas A&M University, 2007-

Member, Independent Advisory Panel on Chemical Security, Dow Chemical Company, 2006.

Reviewer, “Terrorism and the Chemical Infrastructure: Protecting People and Reducing Vulnerabilities,” National Academy of Sciences, 2006.

Accident Investigation Committee, Korea Gas Safety Corporation, 2005-

Editor, Special Issue—Modeling of Complex Processes, Computers and Chemical Engineering, vol. 29, Issues 11-12, October 15, 2005.

National Academy of Science, Committee on Mustard Processing at Tooele Chemical Agent Disposal Facility, 2004-2005.

Presidential Task Force on University Apartment Fire, Texas A&M University, 2004.

Texas Engineering Experiment Station, Research Fellow, 2004.

Member, Advisory Council, Institute for Food Science and Engineering, Texas A&M University, September 2004 –

Expert Panel, Peer Review, Hazardous Substances Emergency Events Surveillance Program, Agency for Toxic Substances and Disease Registry, Centers for Disease Control, Atlanta, Georgia, 2004.

George Armistead, Jr. ’23 Fellow, 2004-2005, Dwight Look College of Engineering, Texas A&M University.

Distinguished Achievement Award for Teaching, The Association of Former Students, Texas A&M University, 2003.

George Armistead, Jr. ’23 Fellow, 2003-2004, Dwight Look College of Engineering, Texas A&M University.

Resume for M. Sam Mannan, PhD, PE, CSP

Consultant to Columbia Accident Investigation Board, 2003.

Editorial Board, Process Safety and Environmental Protection, Transactions of the Institute of Chemical Engineers, 2003-

Editor, F.P. Lees' Loss Prevention for the Process Industries, vol. I-III.

Editor, Special Issue, Journal of Hazardous Materials, 2002-

Texas Engineering Experiment Station, Research Fellow, 2002.

Who's Who in America, 55th Edition, 2001.

Editorial Review Board, Process Safety Progress, 2001-

Service to Society, 2000 Award from the American Institute of Chemical Engineers.

Outstanding Young Men of America, 1988.

Instructor of AIChE short course entitled *Process Equipment Integrity*, 1993-1997.

Instructor of AIChE short course entitled *Role of Operations and Maintenance in the Implementation of Process Safety Management Programs*, 1996-1998.

"Certificate of Recognition," from the American Institute of Chemical Engineers for serving as Chair of the Continuing Education Advisory Committee, 1995-1997.

Advisor on technology transfer for process safety standards and practices for the Petroleum Association of Japan, 1998-present.

Chair, Peer Review Panel, US Environmental Protection Agency, Powell-Duffryn Incident Investigation, 1998-1999.

Conoco President's Safety, Health, and Environment Awards Committee, 1998-2001.

Quality Recognition Award from PPG Industries, Inc. The award recognizes the untiring dedication to envision, create, nourish, and implement a highly successful "Beyond Regulatory Compliance: Making Safety Second Nature" Symposium, 1998.

External Examiner, National University of Singapore for process safety curriculum and Master's program in chemical engineering, 1998-present.

American Institute of Chemical Engineers 11A Committee, "Process Safety and Loss Prevention," 1998-present.

Director, Safety & Health Division, American Institute of Chemical Engineers, 1999-2002.

PEER-REVIEWED JOURNAL PUBLICATIONS

1. Starling, K.E. and M. Mannan, "AGA Compressibility-Factor Correlation Describes Rich Pipeline-Quality Natural Gas", Oil & Gas Journal, November 16, 1987, pp. 49-52.
2. Mannan, M. and K. E. Starling, "Equation-of-State Vapor-Liquid Equilibrium Prediction Methodology for Systems Containing Undefined Fractions", FUEL v. 67, no. 6, pp. 815-821, 1988.
3. Mannan, M., J.L. Savidge and K.E. Starling, "Equation Predicts Supercompressibility for Wet, Sour Gases", Oil & Gas Journal, January 2, 1989, p. 31-39.
4. Mannan, M., M.A. Khan, L.L. Lee and K.E. Starling, "Mixture Equations of State: Composition Dependence", International Journal of Physics, vol. 11, no. 2, pp. 373-380, 1990.
5. Mannan, M., D.B. Pfenning and C.D. Zinn, "Risk Analysis Procedures Ensure System Safety", Oil & Gas Journal, June 3, 1991, p. 83-87, June 10, 1991, p. 34-35.
6. Mannan, M., D.B. Pfenning and H.H. West, "Gas Pipeline Failure: Causes and Mitigation," Pipeline Industry, vol. 75, no. 7, pp. 37-39, July 1992.
7. Mannan, M., "Boiler Incident Directly Attributable to PSM Issues," Process Safety Progress, vol. 15, no. 4, pp. 258-261, Winter 1996.
8. Mannan, M., and M. Dreux, "EPA's Risk Management Program: An Overview," Occupational Hazards, March 1997, pp. 65-77.
9. West, H.H., M.S. Mannan, R. Danna and E.M. Stafford, "Make Plants Safer with a Proper Management of Change Program," Chemical Engineering Progress, June 1998, pp. 25-36.
10. Mannan, M.S., "Perspectives on Risk Communication and Dialogue for the Process Industries," Global Chemical Processing & Engineering Industry, published by the World Market Research Centre, London, United Kingdom, February 1999, pp. 84-89.
11. Mannan, M.S., T.M. O'Connor, and H.H. West, "Accident History Database: An Opportunity," Environmental Progress, vol. 18, no.1, Spring 1999, pp. 1-6.
12. Iglesias-Silva, G.A., M.S. Mannan, F.Y. Shaikh, and K.R. Hall, "Excess Virial Coefficients with Application in Data Analysis," Journal of Fluid Phase Equilibria, vol. 161, 1999, pp. 33-43.
13. Mannan, M.S., A. Akgerman, R.G. Anthony, R. Darby, P.T. Eubank, and K.R. Hall, "New Challenges in Chemical Engineering: Integrating Process Safety into Chemical Engineering Education and Research," Chemical Engineering Education, vol. 33, no. 3, Summer 1999, pp. 198-209.

14. Rosenthal, I. and M.S. Mannan, "Chemical Process Safety: National Goal Setting," Chemical Engineering Progress, March 2000, pp. 55-62.
15. Mannan, M.S. and J.T. Baldwin, "Inherently Safer is Inherently Cleaner: A Comprehensive Design Approach," Chemical Process Safety Report, March 2000, Tab. 100, pp. 125-132.
16. Eubank, P.T., M.S. Mannan, and K.R. Hall, "Simplified Flash Calculations for Process Applications," Chemical Engineering, May 2000, pp. 125-130.
17. Mannan, M.S. and D.L. Kilpatrick, "The Pros and Cons of Shelter-In-Place," Process Safety Progress, vol. 19, no. 4, December 2000, pp. 210-218.
18. Cisneros, L.O., W.J. Rogers and M.S. Mannan, "Adiabatic Calorimetric Decomposition Studies of 50-wt% Hydroxylamine/Water," Journal of Hazardous Materials, vol. 82, no. 1, 2001, pp. 13-24.
19. Frenkel, M., G.A. Iglesias-Silva, M.S. Mannan and K.R. Hall, "Fitting Vapor Pressure - Temperature Data: Simplicity and Unintended Consequences," J. Fluid Phase Equilibria, vol. 183-184, 2001, pp. 217-228.
20. Al-Qurashi, F., G. Sharma, W.J. Rogers, and M. Sam Mannan, "Application of Relational Chemical Process Safety Databases for Lowering Mean Failure Rates," Process Safety Progress, vol. 20, no. 4, December 2001, pp. 280-285.
21. Sukmarg, P., K. Krishna, W.J. Rogers, K.D. Kihm, and M.S. Mannan, "Non-intrusive Characterization of Heat Transfer Aerosol Sprays Released from an Orifice," Journal of Loss Prevention in the Process Industries, vol. 15, no. 1, January 2002, pp. 19-27.
22. Keren, N., H.H. West, and M.S. Mannan, "Benchmarking MOC Practices in the Process Industry," Process Safety Progress, vol. 21, no. 2, June 2002, pp. 103-112.
23. Wang, Y., T.L. Teague, H.H. West, and M.S. Mannan, "A New Algorithm for Computer-aided Fault-Tree Synthesis," Journal of Loss Prevention in the Process Industries, vol. 15, no. 4, July 2002, pp. 265-277.
24. Aldeeb, A.A., W.J. Rogers, and M.S. Mannan, "Theoretical and Experimental Methods for the Evaluation of Reactive Chemical Hazards," Transactions of the Institute of Chemical Engineers, Part B, Process Safety and Environmental Protection, vol. 80, part B, May 2002, pp. 141-149.
25. Vidal, M., J.P. Wagner, W.J. Rogers, and M.S. Mannan, "Charge Generation During Filling of Insulated Tanks," Process Safety Progress, vol. 21, no. 3, September 2002, pp. 181-184.
26. Aldeeb, A.A., W.J. Rogers, and M.S. Mannan, "Understanding the Role of Process

- Chemistry in Fires and Explosions,” Process Safety Progress, vol. 21, no. 4, December 2002, pp 323-328.
27. Cisneros, L.O., W.J. Rogers, and M.S. Mannan, “Effect of Air in the Thermal Decomposition of 50 wt.% Hydroxylamine/water,” Journal of Hazardous Materials, vol. 95, no. 1-2, 2002, pp. 13-25.
 28. Krishna, K., T.K. Kim, K.D. Kihm, W.J. Rogers, and M.S. Mannan, “Predictive Correlations for Leaking Heat Transfer Fluid Aerosols in Air,” Journal of Loss Prevention in the Process Industries, vol. 16, no. 1, January 2003, pp. 1-8.
 29. Saraf, S.R., W.J. Rogers, M.S. Mannan, M.B. Hall, and L.M. Thomson, “Theoretical Thermochemistry: Ab initio Heat of Formation for Hydroxylamine,” Journal of Physical Chemistry, A, vol. 107, no. 8, February 27, 2003, pp 1077-1081.
 30. Saraf, S.R., W.J. Rogers, and M.S. Mannan, “Prediction of Reactive Hazards Based on Molecular Structure,” Journal of Hazardous Materials, vol. 98, no. 1-3, March 2003, pp. 15-29.
 31. Saraf, S.R., W.J. Rogers, and M.S. Mannan, “Application of Transition State Theory for Thermal Stability Prediction,” Industrial and Engineering Chemistry Research, vol. 42, no. 7, 2003, pp. 1341-1346.
 32. Mannan, M.S., W.J. Rogers, M. Gentile, and T.M. O’Connor, “Inherently Safer Design: Implementation Challenges Faced by New and Existing Facilities,” Hydrocarbon Processing, vol. 82, no. 3, March 2003, pp. 59-61.
 33. Cisneros, L.O., X. Wu, W.J. Rogers, M.S. Mannan, J. Park, and S.W. North, “Decomposition Products of 50 mass% Hydroxylamine/water Under Runaway Reaction Conditions,” Transactions of the Institute of Chemical Engineers, Part B, Process Safety and Environmental Protection, vol. 81, no. B2, March 2003, pp. 121-124.
 34. Gentile, M., W.J. Rogers, and M.S. Mannan, “Development of a Fuzzy Logic-Based Inherent Safety Index,” AIChE Journal, vol. 49, Issue 4, April 2003, pp. 959-968.
 35. Aldeeb, A.A., W.J. Rogers, and M.S. Mannan, “New Method Estimates the Parameters for Evaluating Process Reactivity Hazards,” Oil & Gas Journal, vol. 101, no. 24, June 23, 2003, pp. 66-70.
 36. Gupta, J.P., G. Khemani, and M.S. Mannan, “Calculation of Fire & Explosion Index (F&EI) Value for the Dow Guide taking credit for the Loss Control Measures,” Journal of Loss Prevention in the Process Industries, vol. 16, no. 4, July 2003, pp. 235-241.
 37. Mannan, M.S., W.J. Rogers, J.T. Baldwin, J.P. Gupta, Y. Wang, S.R. Saraf, and K. Krishna, “Hydroxylamine Production: Will a QRA Help You Decide,” Reliability Engineering and System Safety, vol. 81, no. 2, August 2003, pp. 215-224.

38. Wang, Y., H.H. West, T.L. Teague, N. Hasan, and M.S. Mannan, "Correlation of Quantitative Risk Results for High Hazard Processes," Risk Analysis, vol. 23, no. 5, 2003, pp. 937-943.
39. Wang, Y., W.J. Rogers, H.H. West and M.S. Mannan, "Algorithmic Fault Tree Synthesis for Control Loops," Journal of Loss Prevention in the Process Industries, vol. 16, no. 5, September 2003, pp. 427-441.
40. Krishna, K., W.J. Rogers, and M.S. Mannan, "The Use of Aerosol Formation, Flammability, and Explosion Information for Heat Transfer Fluid Selection," Journal of Hazardous Materials, vol. 104, no. 1-3, November 2003, pp. 215-226.
41. Roberts, M., W.J. Rogers, M.S. Mannan, and S.W. Ostrowski, "Prevention and Suppression of Metal Packing Fires," Journal of Hazardous Materials, vol. 104, no. 1-3, November 2003, pp. 247-253.
42. Keren, N., H.H. West, W.J. Rogers, J.P. Gupta, and M.S. Mannan, "Use of Failure Rate Databases and Process Safety Performance Measurements to Improve Process Safety," Journal of Hazardous Materials, vol. 104, no. 1-3, November 2003, pp. 75-93.
43. Aldeeb, A., W.J. Rogers, and M.S. Mannan, "Evaluation of Styrene-Acrylonitrile Copolymerization Thermal Stability and Runaway Behavior," Journal of Hazardous Materials, vol. 104, no. 1-3, November 2003, pp. 269-282.
44. Saraf, S.R., W.J. Rogers, and M.S. Mannan, "Using Screening Test Data to Classify Reactive Chemical Hazards," Journal of Hazardous Materials, vol. 104, no. 1-3, November 2003, pp. 255-267.
45. Cisneros, L.O., W.J. Rogers, M.S. Mannan, X. Li, and H. Koseki, "Effect of Iron Ion in the Thermal Decomposition of 50 mass% Hydroxylamine/water Solutions," Journal of Chemical and Engineering Data, vol. 48, no. 5, September 2003, pp. 1164-1169.
46. Gupta, J.P., D.C. Hendershot, and M.S. Mannan, "The Real Cost of Process Safety – A Clear Case for Inherent Safety," Transactions of the Institute of Chemical Engineers, Part B, Process Safety and Environmental Protection, vol. 81, no. B6, November 2003, pp. 406-413.
47. Gentile, M., W.J. Rogers, and M.S. Mannan, "Development of a Fuzzy Logic-based Inherent Safety Index," Transactions of the Institute of Chemical Engineers, Part B, Process Safety and Environmental Protection, vol. 81, no. B6, November 2003, pp. 444-456.
48. Zhou, Y., N. Kazantzis, J. Hahn, and M. Sam Mannan, "Fault Diagnosis in Batch Processes Based on Neural Network with Input Feature Extraction," ISA Transactions, vol. 42, no. 3, 2003, pp. 651-664.

49. Sposato, C., F. Tamanini, W.J. Rogers, and M.S. Mannan, "Effects of Plate Impingement on the Flammable Volumes of Fuel Jet Releases," Process Safety Progress, vol. 22, no. 4, December 2003, pp. 201-211.
50. Saraf, S.R., W.J. Rogers, and M.S. Mannan, "Classifying Reactive Chemicals," Chemical Engineering Progress, vol. 100, no. 3, March 2004, pp. 34-37.
51. Vidal, M., W.J. Rogers, J.C. Holste, and M.S. Mannan, "A Review of Estimation Methods for Flash Points and Flammability Limits," Process Safety Progress, vol. 23, no. 1, March 2004, pp. 47-55.
52. Cisneros, L.O., W.J. Rogers, M.S. Mannan, "Comparison of the thermal decomposition behavior for members of the hydroxylamine family," Thermochimica Acta, vol. 414, no. 2, May 2004, pp. 177-183.
53. Triplett, T.L., Y. Zhou, and M.S. Mannan, "Application of Chain of Events Analysis to Process Safety Management," Process Safety Progress, vol. 23, no. 2, June 2004, pp. 132-135.
54. Krishna, K., W.J. Rogers, and M.S. Mannan, "Consider Aerosol Formation When Selecting Heat Transfer Fluids," Chemical Engineering Progress, vol. 100, no. 7, July 2004, pp. 25-28.
55. Wei, C., W.J. Rogers, and M.S. Mannan, "Application of Screening Tools in the Prevention of Reactive Chemical Incidents," Journal of Loss Prevention in the Process Industries, vol. 17, no. 4, July 2004, Pages 261-269.
56. Saraf, S.R., W.J. Rogers, D.M. Ford, and M.S. Mannan, "Integrating Molecular Modeling and Process Safety Research," Fluid Phase Equilibria, vol. 222-223, 2004, pp. 205-211.
57. Wei, C., S.R., Saraf, W.J. Rogers, and M.S. Mannan, "Thermal Runaway Reaction Hazards and Mechanisms of Hydroxylamine With Acid/Base Contaminants," Thermochimica Acta, vol. 421, no. 1-2, November 2004, pp. 1-9.
58. Rajaraman, S., J. Hahn, and M.S. Mannan, "A Methodology for Fault Detection, Isolation, and Identification for Nonlinear Processes with Parametric Uncertainties," Industrial and Engineering Chemistry Research, vol. 43, no. 21, 2004, pp. 6774-6786.
59. Fang, J.S., D.M. Ford, and M.S. Mannan, "Making the Business Case for Process Safety Using Value-at-Risk Concepts," Journal of Hazardous Materials, vol. 115, no. 1-3, November 2004, pp. 17-26.
60. Aldeeb, A.A., W.J. Rogers, and M.S. Mannan, "Evaluation of 1,3-Butadiene Dimerization and Secondary Reactions in the Presence and Absence of Oxygen," Journal of Hazardous Materials, vol. 115, no. 1-3, November 2004, pp. 51-56.

61. Whiteley, R.W., and M.S. Mannan, "Initial Perspectives on Process Threat Management," Journal of Hazardous Materials, vol. 115, no. 1-3, November 2004, pp. 163-167.
62. Wang, Y., H.H. West, and M.S. Mannan, "The Impact of Data Uncertainty in Determining Safety Integrity Level," Transactions of the Institute of Chemical Engineers, Part B, Process Safety and Environmental Protection, vol. 82, no. B6, November 2004, pp. 393-397.
63. Cisneros, L.O., W.J. Rogers, M.S. Mannan, "Adiabatic calorimetric decomposition studies of 35 mass% Hydroxylamine Hydrochloride/water," The Canadian Journal of Chemical Engineering, vol. 82, no. 6, December 2004, pp. 1307-1312.
64. Mannan, M.S., "Challenges in Implementing Inherent Safety Principles," Industrial Process Products and Technology, vol. 18, no. 1, February 2005, pp. 32.
65. Mannan, M.S., "The Mary Kay O'Connor Process Safety Center—the first ten years," Hydrocarbon Processing, vol. 85, no. 3, March 2005, pp. 65-71.
66. Wang, Y., H.H. West, N. Hasan, and M.S. Mannan, "QRA Study of an Activated Carbon Filter SafeGuard System," Transactions of the Institute of Chemical Engineers, Part B, Process Safety and Environmental Protection, vol. 83, no. B2, March 2005, pp. 191-196.
67. West, H.H., Y. Qiao, and M.S. Mannan, "LNG-Water Rapid Phase Transition: Part 1 – A Literature Review," LNG Journal, May 2005, pp. 21-24.
68. Liu, Y-S., V.M. Ugaz, W.J. Rogers, M.S. Mannan, and S.R. Saraf, "Development of an Advanced Nanocalorimetry System for Material Characterization," Journal of Loss Prevention in the Process Industries, vol. 18, no. 3, May 2005, pp. 139-144.
69. Keren, N., H.H. West, and M.S. Mannan, "Benchmarking of Emergency Preparedness and Response Practices in the Process Industry," Journal of Emergency Management, vol. 3, no. 3, May/June 2005, pp. 25-32.
70. West, H.H., Y. Qiao, and M.S. Mannan, "LNG-Water Rapid Phase Transition: Part 2 – Incident Analysis," LNG Journal, July/August 2005, pp. 28-30.
71. Mannan, M.S., H.H. West, K. Krishna, A.A. Aldeeb, N. Keren, S.R. Saraf, Y.-S. Liu, and M. Gentile, "The Legacy of Bhopal: The Impact Over the Last 20 Years and Future Direction," Journal of Loss Prevention in the Process Industries, vol. 18, no. 4-6, July-November 2005, pp. 218-224.
72. Vidal, M., W.J. Rogers, and M.S. Mannan, "Prediction of Minimum Flash Point Behavior for Binary Mixtures," Transactions of the Institute of Chemical Engineers, Part B, Process Safety and Environmental Protection, vol. 84, no. B1, January 2006, pp. 1-9.

-
73. Wei, C., W.J. Rogers, and M.S. Mannan, "Detection of Autocatalytic Decomposition Behavior of Energetic Materials Using APTAC," Journal of Thermal Analysis and Calorimetry, vol. 83, no. 1, January 2006, pp. 125-130.
74. Badders, N.R., C. Wei, A.A. Aldeeb, W.J. Rogers, and M.S. Mannan, "Predicting the Impact Sensitivities of Energetic Materials Using Quantum Chemical Descriptors," Journal of Energetic Materials, vol. 24, no. 1, January-March 2006, pp. 17-33.
75. Rajaraman, S., J. Hahn, and M.S. Mannan, "Sensor Fault Diagnosis for Nonlinear Processes With Parametric Uncertainties," Journal of Hazardous Materials, vol. 130, no. 1-2, March 2006, pp. 1-8.
76. Vidal, M., W. Wong, W.J. Rogers and M.S. Mannan, "Evaluation of Lower Flammability Limits of Fuel-Air-Diluent Mixtures Using Calculated Adiabatic Flame Temperatures," Journal of Hazardous Materials, vol. 130, no. 1-2, March 2006, pp. 21-27.
77. Anand, S., N. Keren, M.J. Tretter, Y. Wang, T.M. O'Connor, and M.S. Mannan, "Harnessing Data Mining to Explore Incident Databases," Journal of Hazardous Materials, vol. 130, no. 1-2, March 2006, pp. 33-41.
78. Olive, C., T.M. O'Connor, and M.S. Mannan, "Relationship of Safety Culture and Process Safety," Journal of Hazardous Materials, vol. 130, no. 1-2, March 2006, pp. 133-140.
79. Qiao, Y., H.H. West, M.S. Mannan, D.W. Johnson, and J.B. Cornwell, "Assessment of the Effects of Release Variables on the Consequences of LNG Spillage onto Water Using FERC Models," Journal of Hazardous Materials, vol. 130, no. 1-2, March 2006, pp. 155-162.
80. Wei, C., W.J. Rogers, and M.S. Mannan, "Thermal Decomposition Hazard Evaluation of Hydroxylamine Nitrate," Journal of Hazardous Materials, vol. 130, no. 1-2, March 2006, pp. 163-168.
81. Mitchell, S.M. and M.S. Mannan, "Designing Resilient Engineered Systems," Chemical Engineering Progress, vol. 102, no. 4, April 2006, pp. 39-45.
82. Zhou, Y., J. Hahn, and M.S. Mannan, "Process Monitoring Based on Classification Tree and Discriminant Analysis," Reliability Engineering and System Safety, vol. 91, no. 5, May 2006, pp. 495-626.
83. Liu, Y-S., W.J. Rogers, and M.S. Mannan, "Effective and Practical Tools for Screening Reactive Hazards," Chemical Engineering Progress, vol. 102, no. 5, May 2006, pp. 41-47.
84. Mannan, M.S., K.S. Park, Y-D. Jo, J-Y. Kim, N. Keren, and Y. Wang, "Incident Analysis of Bucheon LPG Filling Station Pool Fire and BLEVE," Journal of Hazardous Materials,

vol. 137, no. 1, September 2006, pp. 62-67.

85. Keren, N., S. Anand, and M.S. Mannan, "Calibrate Failure-Based Risk Assessments to Take Into Account the Type of Chemical Processed in Equipment," Journal of Loss Prevention in the Process Industries, vol. 19, no. 6, November 2006, pp. 714-718.
86. Wei, C., W.J. Rogers, and M.S. Mannan, "Application of Runaway Reaction Mechanism Generation to Predict and Control Reactive Hazards," Computers and Chemical Engineering, vol. 31, issue 3, January 2007, pp. 121-126.
87. Fang, J.S., M.S. Mannan, D.M. Ford, J. Logan, and A. Summers, "Value at Risk Perspective on Layers of Protection Analysis," Transactions of the Institute of Chemical Engineers, Part B, Process Safety and Environmental Protection, vol. 85, no. B1, January 2007, pp. 81-87.
88. Suardin, J.A., M.S. Mannan, and M.M. El-Halwagi, "The Integration of Dow's Fire and Explosion Index (F&EI) into Process Design and Optimization to Achieve Inherently Safety Design," Journal of Loss Prevention in the Process Industries, vol. 20, no. 1, January 2007, pp. 79-90.
89. Liu, Y.-S., V.M. Ugaz, S.W. North, W.J. Rogers and M.S. Mannan, "Development of a Miniature Calorimeter for Identification and Detection of Explosives and Other Energetic Compounds," Journal of Hazardous Materials, vol. 142, no. 3, April 2007, pp. 662-668.
90. Wei, C., W.J. Rogers, and M.S. Mannan, "Understanding Reactive Hazards using Molecular Simulation: Mechanisms of Hydroxylamine Decomposition," Chemical Engineering Communications, vol. 194, no. 5, May 2007, pp. 579-585.
91. Narayanan, D., Y. Zhang, and M.S. Mannan, "Engineering for Sustainable Development (ESD) in Bio-Diesel Production," Transactions of the Institute of Chemical Engineers, Part B, Process Safety and Environmental Protection, vol. 85, no. B5, September 2007, pp. 349-359.
92. Mannan, M.S., H.H. West, and P.C. Berwanger, "Lessons Learned from Recent Incidents: Facility Siting, Atmospheric Venting, and Operator Information Systems," Journal of Loss Prevention in the Process Industries, vol. 20, Issues 4-6, July-November 2007, pp. 644-650.
93. Al-Mutairi, E.M., J.A. Suardin, M.S. Mannan and M.M. El-Halwagi, "An Optimization Approach to the Integration of Inherently-Safer Design and Process Scheduling," Journal of Loss Prevention in the Process Industries, vol. 21, Issue 5, September 2008, pp. 543-549.
94. Wei, C., W.J. Rogers and M.S. Mannan, "Layer of Protection Analysis for Reactive Chemical Risk Assessment," Journal of Hazardous Materials, vol. 159, no. 1, November 2008, pp. 19-24.

-
95. Markowski, A. and M.S. Mannan, "Fuzzy Risk Matrix," Journal of Hazardous Materials, vol. 159, no. 1, November 2008, pp. 152-157.
96. Rana, M.A., B.R. Cormier, J.A. Suardin, Y. Zhang and M.S. Mannan, "Experimental Study of Effective Water Spray Curtain Application in Dispersing LNG Vapor Clouds," Process Safety Progress, vol. 27, no. 4, December 2008, pp. 345-353.
97. Dinh, L.T.T., W.J. Rogers and M.S. Mannan, "Reactivity of Ethylene Oxide in Contact with Basic Contaminants," Thermochimica Acta, vol. 480, no. 1-2, December 2008, pp. 53-60.
98. Díaz-Ovalle, C.O., R. Vázquez-Román y M.S. Mannan, "Determinación de los Factores del Peor Escenario en la Emisión de Gases Tóxicos," Información Tecnológica, vol. 20, no. 1, pp. 3-10, 2009.
99. Yun, G.W., W.J. Rogers and M.S. Mannan, "Risk Assessment of an LNG Importation Terminal using Bayesian-LOPA Methodology," Journal of Loss Prevention in the Process Industries, vol. 22, no. 1, January 2009, pp. 91-96.
100. Liu, L., Y. Guo, W.J. Rogers and M.S. Mannan, "Computational Fluid Dynamics Analysis on the Critical Behavior of Reactive Chemicals," Journal of Loss Prevention in the Process Industries, vol. 22, no. 2, March 2009, pp. 187-196.
101. Zhao, F., W.J. Rogers and M.S. Mannan, "Experimental Measurement and Numerical Analysis of Binary Hydrocarbon Mixture Flammability Limits," Transactions of the Institute of Chemical Engineers, Part B, Process Safety and Environmental Protection, vol. 87, no. 2, March 2009, pp. 94-104.
102. Henning, J. B., C.J. Stuft, S.C. Payne, M.E. Bergman, M.S. Mannan and N. Keren, "The influence of individual differences on organizational safety attitudes," Safety Science, vol. 47, no. 3, March 2009, pp. 337-345.
103. Liu, L., C. Wei, Y. Guo, W.J. Rogers, and M. Sam Mannan, "Hydroxylamine Nitrate Self-Catalytic Kinetics Study with Adiabatic Calorimetry," Journal of Hazardous Materials, vol. 162, no. 2-3, March 2009, pp. 1217-1222.
104. Mannan, M.S., T.M. O'Connor and N. Keren, "Patterns and Trends in Injuries Due to Chemicals Based on OSHA Occupational Injury and Illness Statistics," Journal of Hazardous Materials, vol. 163, no. 1, April 2009, pp. 349-356.
105. Dinh, L.T.T., Y. Guo and M.S. Mannan, "Sustainability Evaluation of Biodiesel Production Using Multi Criteria Decision-Making," Environmental Progress, vol. 28, no. 1, April 2009, pp. 38-46.
106. Cormier, B.R., R. Qi, G.W. Yun, Y. Zhang and M.S. Mannan, "Application of

- Computational Fluid Dynamics for LNG Vapor Dispersion Modeling: A Study of Key Parameters,” Journal of Loss Prevention in the Process Industries, vol. 22, no. 3, May 2009, pp. 332-352.
107. Suardin, J.A., A.J. McPhate Jr, A. Sipkema, M. Childs and M.S. Mannan, “Fire and explosion assessment on oil and gas floating production storage offloading (FPSO): An effective screening and comparison tool,” Transactions of the Institute of Chemical Engineers, Part B, Process Safety and Environmental Protection, vol. 87, no. 3, May 2009, pp. 147-160.
108. Wang, Q., Y. Zhang, W.J. Rogers and M.S. Mannan, “Molecular Simulation Studies on Chemical Reactivity of Methylcyclopentadiene,” Journal of Hazardous Materials, vol. 165, no. 1-3, June 2009, pp. 141-147.
109. Liu, L., M. Papadaki, E. Pontiki, P. Stathi, W.J. Rogers and M.S. Mannan, “Isothermal Decomposition of Hydroxylamine and Hydroxylamine Nitrate in Aqueous Solutions in the Temperature Range 80-160°C,” Journal of Hazardous Materials, vol. 165, no. 1-3, June 2009, pp. 573-578.
110. Suardin, J.A., Y. Wang, M. Willson and M.S. Mannan, “Field Experiment on High Expansion Foam (HEX) Application for Controlling LNG Pool Fire,” Journal of Hazardous Materials, vol. 165, no. 1-3, June 2009, pp. 612-622.
111. Papadaki, M., E. Pontiki, L. Liu, W.J. Rogers and M.S. Mannan, “Thermal Behavior of Aqueous Solutions of Hydroxylamine During Isothermal and Isoperibolic Decomposition in a Closed System,” Journal of Chemical and Engineering Data, vol. 54, no. 9, 2009, pp. 2616-2621.
112. Qiao, Y., N. Keren and M.S. Mannan, “Utilization of Accident Databases and Fuzzy Sets to Estimate Frequency of HazMat Transport Accidents,” Journal of Hazardous Materials, vol. 167, no. 1-3, August 2009, pp. 374-382.
113. Patel, S.J., D. Ng and M.S. Mannan, “QSPR flash point prediction of solvents using topological indices for application in computer aided molecular design,” Industrial and Engineering Chemistry Research, vol. 48, no. 15, 2009, pp. 7378-7387.
114. Wang, Q., D. Ng and M.S. Mannan, “Study on the Reaction Mechanism and Kinetics of the Thermal Decomposition of Nitroethane,” Industrial and Engineering Chemistry Research, vol. 48, no. 18, 2009, pp. 8745-8751.
115. Wang, Q., W.J. Rogers and M.S. Mannan, “Thermal Risk Assessment and Rankings for Reaction Hazards in Process Safety,” Journal of Thermal Analysis and Calorimetry, vol. 98, no. 1, October 2009, pp. 225-233.
116. Markowski, A.S., M.S. Mannan, and A. Bigoszezewska, “Fuzzy Logic for Process Safety Analysis,” Journal of Loss Prevention in the Process Industries, vol. 22, no. 6,

November 2009, pp. 695-702.

117. Saenz, L., V.H. Carreto-Vazquez, L. Liu, W.J. Rogers, M.S. Mannan, M. Papadaki, "2-Methylpyridine-N-oxidation runaway studies," Journal of Loss Prevention in the Process Industries, vol. 22, no. 6, November 2009, pp. 839-843.
118. Markowski, A.S., and M.S. Mannan, "Fuzzy Logic for Piping Risk Assessment (pfLOPA)," Journal of Loss Prevention in the Process Industries, vol. 22, no. 6, November 2009, pp. 921-927.
119. Vázquez-Román, R., J.-H. Lee, S. Jung, and M.S. Mannan, "Optimal facility layout under toxic release in process facilities: A stochastic approach," Computers and Chemical Engineering, vol. 34, Issue 1, January 2010, pp. 122-133.
120. Carreto-Vázquez, V.H., I. Hernández, D. Ng, W.J. Rogers, M.S. Mannan, "Inclusion of Pressure Hazards into NFPA-704 Instability Rating System," Journal of Loss Prevention in the Process Industries, vol. 23, no. 1, January 2010, pp. 30-38.
121. Rana, M.A., Y. Guo and M.S. Mannan, "Use of Water Spray Curtain to Disperse LNG Vapor Clouds," Journal of Loss Prevention in the Process Industries, vol. 23, no. 1, January 2010, pp. 77-88.
122. Jung, S., D. Ng, J.-H. Lee, R. Vázquez-Román and M.S. Mannan, "An approach for risk reduction (methodology) based on optimizing the facility layout and siting in toxic gas release scenarios," Journal of Loss Prevention in the Process Industries, vol. 23, no. 1, January 2010, pp. 139-148.
123. Yang, X., W.J. Rogers and M.S. Mannan, "Uncertainty delimitation and reduction for improved mishap probability prediction: application to level control of distillation unit," Journal of Loss Prevention in the Process Industries, vol. 23, no. 1, January 2010, pp. 149-156.
124. Zhao, F., W.J. Rogers and M.S. Mannan, "Calculated Flame Temperature (CFT) Modeling of Fuel Mixture Lower Flammability Limits," Journal of Hazardous Materials, vol. 174, no. 1-3, February 2010, pp. 416-423.
125. Prem, K.P., D. Ng, M. Sawyer, Y. Guo, H.J. Pasman and M.S. Mannan, "Risk measures constituting a risk metrics which enables improved decision making: Value-at-Risk," Journal of Loss Prevention in the Process Industries, vol. 23, no. 2, March 2010, pp. 211-219.
126. Yang, X. and M.S. Mannan, "An Uncertainty and Sensitivity Analysis of Dynamic Operational Risk Assessment Model: A Case Study," Journal of Loss Prevention in the Process Industries, vol. 23, no. 2, March 2010, pp. 300-307.

127. Lian, P., A.F. Mejia, Z. Cheng and M.S. Mannan, "Flammability of Heat Transfer Fluid Aerosols Produced by Electrospray Measured by Laser Diffraction Analysis," Journal of Loss Prevention in the Process Industries, vol. 23, no. 2, March 2010, pp. 337-345.
128. Lu, Y., D. Ng, L. Miao and M.S. Mannan, "Key Observations of Cumene Hydroperoxide Concentration on Runaway Reaction Parameters," Thermochimica Acta, vol. 501, no. 1-2, March 2010, pp. 65-71.
129. Safitri A., and M.S. Mannan, "Analysis of methane gas visualization using infrared imaging system and evaluation of temperature dependence gas emissivity," Industrial and Engineering Chemistry Research, vol. 49, no. 8, 2010, pp. 3926-3935.
130. Díaz-Ovalle, C., R. Vázquez-Román and M.S. Mannan, "An approach to solve the facility layout problem based on the worst-case scenario," Journal of Loss Prevention in the Process Industries, vol. 23, no. 3, May 2010, pp. 385-392.
131. Pokoo-Aikins, G., A. Heath, R.A. Mentzer, M.S. Mannan, W.J. Rogers and M.M. El-Halwagi, "A Multi-Criteria Approach to Screening Alternatives for Converting Sewage Sludge to Biodiesel," Journal of Loss Prevention in the Process Industries, vol. 23, no. 3, May 2010, pp. 412-420.
132. Markowski, A.S., M.S. Mannan, A. Kotynia-Bigoszewska, and D. Siuta, "Uncertainty aspects in process safety analysis," Journal of Loss Prevention in the Process Industries, vol. 23, no. 3, May 2010, pp. 445-454.
133. Patel, S.J., D. Ng and M.S. Mannan, "Integration of Safety Issues in Conceptual Design of Solvent Processes," Journal of Loss Prevention in the Process Industries, vol. 23, no. 4, July 2010, pp. 483-491.
134. Prem, K.P., D. Ng and M.S. Mannan, "Harnessing Database Resources for Understanding the Profile of Chemical Process Industry Incidents," Journal of Loss Prevention in the Process Industries, vol. 23, no. 4, July 2010, pp. 549-560.
135. Yang, X. and M.S. Mannan, "The Development and Application of Dynamic Operational Risk Assessment in Oil/Gas and Chemical Process Industry," Reliability Engineering and System Safety, vol. 95, no. 7, July 2010, pp. 806-815.
136. Wang, Q., C. Wei, L.M. Perez, W.J. Rogers, M.B. Hall and M.S. Mannan, "Thermal Decomposition Pathways of Hydroxylamine: Theoretical Investigation on the Initial Steps," Journal of Physical Chemistry, A, vol. 114, no. 34, August 2, 2010, pp. 9262-9269.
137. Wang, Q. and M.S. Mannan, "Prediction of Thermochemical Properties for Gaseous Ammonia Oxide," Journal of Chemical and Engineering Data, vol. 55, no. 11, September 9, 2010, pp. 5128-5132.

138. Qi, R., D. Ng, B.R. Cormier and M.S. Mannan, "Simulation of LNG Vapor Dispersion in Brayton Fire Training Field Test with ANSYS CFX," Journal of Hazardous Materials, vol. 183, no. 1-3, November 2010, pp. 51-61.
139. Markowski, A.S. and M.S. Mannan, "ExSys-LOPA for the chemical process industry," Journal of Loss Prevention in the Process Industries, vol. 24, no. 6, November 2010, pp. 688-696.
140. Rana, M.A. and M.S. Mannan, "Forced dispersion of LNG vapor with water curtain," Journal of Loss Prevention in the Process Industries, vol. 24, no. 6, November 2010, pp. 768-772.
141. Jung, S., D. Ng, C.D. Laird and M.S. Mannan, "A new approach for facility siting using mapping risks on a plant grid area and optimization," Journal of Loss Prevention in the Process Industries, vol. 24, no. 6, November 2010, pp. 824-830.
142. Carreto-Vazquez, V.H., A.K. Wójcik, Y.-S. Liu, D.B. Bukur, and M.S. Mannan, "Miniaturized Calorimeter for Thermal Screening of Energetic Materials," Microelectronics Journal, vol. 41, no. 12, December 2010, pp. 874-881.
143. Carreto-Vazquez, V.H., Y.-S. Liu, D.B. Bukur, and M.S. Mannan, "Chip-Scale Calorimeters – Potential Use in Chemical Engineering," Journal of Loss Prevention in the Process Industries, vol. 24, no. 1, January 2011, pp. 34-42.
144. Suardin, J.A., R. Qi, B.R. Cormier, M. Rana, Y. Zhang, and M.S. Mannan, "Application of fire suppression materials on suppression of LNG pool fires," Journal of Loss Prevention in the Process Industries, vol. 24, no. 1, January 2011, pp. 63-75.

BOOKS

1. Mannan, M.S., West, H.H., Pfenning, D.B., and W.W. Varnado, *Guidelines for Safe Process Operations and Maintenance*, published by the Center for Chemical Process Safety, American Institute of Chemical Engineers, 1995.
2. Mannan, M.S., editor, *Lees' Loss Prevention for the Process Industries*, vol. I-III, 3rd edition, Elsevier Butterworth-Heinemann, Burlington, Massachusetts, 2005.

BOOK CHAPTERS

1. Mannan, M.S., D. Hendershot and T.A. Kletz, "Fundamentals of Process Safety and Risk Management," Encyclopedia of Chemical Processing and Design, ed. R.G. Anthony, vol. 69, Supplement 1, pp. 49-94, Marcel Dekker, Inc., New York, 2002.

2. Mannan, M.S., J. Makris, and H.J. Overman, "Process Safety and Risk Management Regulations: Impact on Process Industry," Encyclopedia of Chemical Processing and Design, ed. R.G. Anthony, vol. 69, Supplement 1, pp. 168-193, Marcel Dekker, Inc., New York, 2002.
3. Szonntag, E.L., H.H. West, and M.S. Mannan, "Purging and Inerting Systems," Instrument Engineers' Handbook, Process Software and Digital Networks, 3rd edition, Editor-in-Chief: B.G. Liptak, pp. 167-172, CRC Press, Boca Raton, Florida, 2002.
4. West, H.H. and M.S. Mannan, "Process Safety Management," Instrument Engineers' Handbook, Process Software and Digital Networks, 3rd edition, Editor-in-Chief: B.G. Liptak, pp. 182-191, CRC Press, Boca Raton, Florida, 2002.
5. Mannan, M.S. and H.H. West, "Process Alarm Management," Instrument Engineers' Handbook, Process Control and Optimization, 4th edition, Editor-in-Chief: B.G. Liptak, pp. 59-63, CRC Press, Boca Raton, Florida, 2006.
6. Rajaraman, S., U. Krueger, M.S. Mannan, and J. Hahn, "A New Sensor Fault Diagnosis Technique Based Upon Subspace Identification and Residual Filtering," Computational Intelligence, Lecture Notes in Computer Science, Eds. D.-S. Huang, K. Li, and G.W. Irwin, vol. 4114, pp. 990-998, Springer, Berlin, Germany, 2006.
7. Cormier, B.R., J.A. Suardin, M. Rana, Y. Zhang and M.S. Mannan, "Development of Design and Safety Specifications for LNG Facilities Based on Experimental and Theoretical Research," in *OPEC, Oil Prices and LNG*, eds. E.R. Pitt and C.N. Leung, pp. 295-424, Nova Science Publishers, New York, New York, 2009.

TECHNICAL MEETING PROCEEDINGS

1. Starling, K.E., C. M. Sliepcevich, and M. Mannan, "Traceability to Standards: Basic Verification for Gas Measurement", proceedings of the 1987 Distribution/Transmission Conference of the American Gas Association, Las Vegas, Nevada, May 4-6, 1987.
2. Starling, K.E., and M. Mannan, "Revised Alternate Characterization Methods for Fast Computation of Supercompressibility Factors for Natural Gas Flow Rate Calculations", pp. 476-491, proceedings of the 1988 Distribution/Transmission Conference of the American Gas Association, Toronto, Canada, May 16-18, 1988.
3. Pfenning, D.B. and M. Mannan, "A Structured Approach for Vapor Dispersion Modeling of Pure and Multicomponent Mixtures", pp. 271-292, Proceedings of the 1992 Process Plant Safety Symposium, Houston, Texas, February 18-19, 1992.
4. Mannan, M. and D.B. Pfenning, "Effective Process Safety Information Management", pp. 1224-1230, Proceedings of the 1992 Process Plant Safety Symposium, Houston, Texas, February 18-19, 1992.

5. Mannan, M., D.B. Pfenning, and H.H. West, "Causes of Pipeline Failure and Prevention and Mitigation Procedures," proceedings of the Conference on Pipeline Risk Assessment, Rehabilitation and Repair at Houston, Texas, May 18-21, 1992.
6. Mannan, M. and R. Danna, "The Use of Compliance Audits and Assessments in Establishment of Program Baselines and Plans for 29 CFR 1910.119," vol. 7, pp. 165-177, proceedings of the 1993 Petro-Safe Conference, Houston, Texas, January 26-28, 1993.
7. Mannan, M. and R. Jacques, "Risk Assessment: A Vehicle for Improving Performance and Reducing Failures Throughout the Life Cycle of a Pipeline," Proceedings of the 3rd International Conference on Pipeline Risk Assessment, Rehabilitation and Repair, Houston, Texas, September 13-16, 1993.
8. Mannan, M., R.C. Keeney, V.J. Bily, and W.S. Lee, "Development of Comprehensive Emergency Response Plans for Compliance With Multiple Regulations," pp. 134-144, proceedings of the Energy Transportation, Transfer and Storage Conference and Exposition, Houston, Texas, January 25-27, 1994.
9. Mannan, M., R.C. Keeney, V.J. Bily, and W.S. Lee, "Disaster Review Procedures and Modeling Required by the Texas Natural Resources Conservation Commission Regulations," pp. 145-158, proceedings of the Energy Transportation, Transfer and Storage Conference and Exposition, Houston, Texas, January 25-27, 1994.
10. Mannan, M., R.C. Keeney, V.J. Bily, and W.S. Lee, "EPA's Risk Management Program Regulation," vol. 2, pp. 220-232, proceedings of the 1994 PETRO-SAFE Conference, Houston, Texas, January 25-27, 1994.
11. Mannan, M., V.J. Bily and R.C. Keeney, "Synergism Between OSHA's Process Safety Management Rule and EPA's Proposed Risk Management Program Rule: Effective Methods of Integration With Process Plant Operations," proceedings of the 1994 Process Plant Safety Symposium, Houston, Texas, February 28 - March 2, 1994.
12. Mannan, M., "Application of Consequence Analysis in Emergency Response Planning for Pipeline Systems," proceeding of the 1994 Conference on Pipeline Risk Assessment, Rehabilitation and Repair, Houston, Texas, September 12-15, 1994.
13. Mannan, M., "Risk Management Planning," proceedings of the 1994 American Chemical Industries Week, Philadelphia, Pennsylvania, October 18-20, 1994.
14. Mannan, M. and E.J. Kiihne, "PSM Case History: Regulatory Compliance Can Prevent Catastrophic Incidents," pp. 128-134, proceedings of the 1995 PETRO-SAFE Conference, Houston, Texas, January 31-February 2, 1995.
15. Mannan, M. and R.C. Keeney, "Corporate Planning for Compliance With EPA's Proposed Risk Management Program Rule," pp. 194-199, proceedings of the 1995 PETRO-SAFE

Conference, Houston, Texas, January 31-February 2, 1995.

16. Mannan, M. and V.J. Bily, "Risk Ranking Methodology for Development of Prioritization Rationale and Determination of Priority Order for Conducting PHAs," pp. 211-213, proceedings of the 1995 PETRO-SAFE Conference, Houston, Texas, January 31-February 2, 1995.
17. Mannan, M., W. Lee and M. Rahman, "Ensuring Regulatory Compliance: Use of Computerized Databases for Tracking PSM Activities and Documentation," pp. 135-145, proceedings of the 1995 PETRO-SAFE Conference, Houston, Texas, January 31-February 2, 1995.
18. Mannan, M., "Role of LEPCs in Risk Management and Risk Communication," pp. 244-247, proceedings of the 1995 PETRO-SAFE Conference, Houston, Texas, January 31-February 2, 1995.
19. Mannan, M. and E.J. Kiihne, "Using Compliance Audits as the Basis for Developing an Effective Mechanical Integrity Program," pp. 64-66, proceedings of the 1996 PETRO-SAFE Conference, Houston, Texas, January 29-February 2, 1996.
20. Mannan, M. and K.B. Bryan, "Design Considerations and Risk Assessment During HAZOP Studies," pp. 85-88, proceedings of the 1996 PETRO-SAFE Conference, Houston, Texas, January 29-February 2, 1996.
21. Mannan, M. and K.R. Ford, "Siting Analyses for Existing Facilities," pp. 67-71, proceedings of the 1996 PETRO-SAFE Conference, Houston, Texas, January 29-February 2, 1996.
22. Mannan, M. and R.G. Rein, Jr., "Comparison of Gaussian and Dense Gas Vapor Dispersion Models for Hazard Assessments," pp. 82-84, proceedings of the 1996 PETRO-SAFE Conference, Houston, Texas, January 29-February 2, 1996.
23. Mannan, M. and W. Lee, "Plant Perspective on Electronic Document Management Systems for Process Safety Management Programs," pp. 105-110, proceedings of the 1996 PETRO-SAFE Conference, Houston, Texas, January 29-February 2, 1996.
24. Mannan, M. and M.S. Him, "Using OSHA's Requirement for the Revalidation of PHA's to Comply With EPA's Proposed Risk Management Rule," pp. 47-50, proceedings of the 1996 PETRO-SAFE Conference, Houston, Texas, January 29-February 2, 1996.
25. Mannan, M., S. Tollette and H. West, "Development of Integrated Pipeline Risk Management Plans for Compliance with Multiple Regulations," proceedings of the 6th Conference on Pipeline Reliability, Houston, Texas, November 18-22, 1996.
26. Mannan, M., S. Tollette and H.H. West "Configuration Management as Risk Assessment Tool for Pipeline Integrity," *Proceedings of the 7th Annual Pipeline Reliability Conference*,

Resume for M. Sam Mannan, PhD, PE, CSP

Houston, Texas, November 17-20, 1997, Section, 12, pp. 1-11, published by Pipes & Pipelines International, Bucks, United Kingdom.

27. McCray, E.T. and M.S. Mannan, "Use of Accident Databases for the Systematic Evaluation of Chemical Accidents," *Proceedings of the 2nd Annual Mary Kay O'Connor Process Safety Center Symposium – Beyond Regulatory Compliance: Making Safety Second Nature*, College Station, Texas, October 26-27, 1999, pp. 47-161.
28. Cisneros, L., W.J. Rogers and M.S. Mannan, "Thermal Runaway Reaction Studies of Poly(ethylene glycol) and Poly(propylene glycol)," *Proceedings of the 2nd Annual Mary Kay O'Connor Process Safety Center Symposium – Beyond Regulatory Compliance: Making Safety Second Nature*, College Station, Texas, October 26-27, 1999, pp. 202-212.
29. West, H.H. and M.S. Mannan, "Spontaneously Combustible Substances, A Database Update," *Proceedings of the 2nd Annual Mary Kay O'Connor Process Safety Center Symposium – Beyond Regulatory Compliance: Making Safety Second Nature*, College Station, Texas, October 26-27, 1999, pp. 267-281.
30. Mannan, M.S., "Process Safety Management Begins and Ends With Process Knowledge and Documentation," *Proceedings of the 55th Annual Instrumentation Symposium*, College Station, Texas, January 25-27, 2000.
31. Al-Qurashi, F., W.J. Rogers and M.S. Mannan, "Analysis of the EPA RMP*INFO Database," *Proceedings of the 3rd Annual Mary Kay O'Connor Process Safety Center Symposium – Beyond Regulatory Compliance: Making Safety Second Nature*, College Station, Texas, October 24-25, 2000, pp. 40-45.
32. Wang, Y., T.L. Teague, H.H. West and M.S. Mannan, "Use of Fault Trees for Quantitative Risk Assessment," *Proceedings of the 3rd Annual Mary Kay O'Connor Process Safety Center Symposium – Beyond Regulatory Compliance: Making Safety Second Nature*, College Station, Texas, October 24-25, 2000, pp. 121-127.
33. Cisneros, L., W.J. Rogers and M.S. Mannan, "Thermal Decomposition Study of Hydroxylamine," *Proceedings of the 3rd Annual Mary Kay O'Connor Process Safety Center Symposium – Beyond Regulatory Compliance: Making Safety Second Nature*, College Station, Texas, October 24-25, 2000, pp. 140-168.
34. Saraf, S., W.J. Rogers and M.S. Mannan, "Application of Ab-Initio Principles for Prediction of Chemical Reactivity," *Proceedings of the 3rd Annual Mary Kay O'Connor Process Safety Center Symposium – Beyond Regulatory Compliance: Making Safety Second Nature*, College Station, Texas, October 24-25, 2000, pp. 199-207.
35. Zhou, Y., N. Kazantzis, H.H. West, W.J. Rogers and M.S. Mannan, "Abnormal Situation Management: A Process Dynamics Approach," *Proceedings of the 3rd Annual Mary Kay O'Connor Process Safety Center Symposium – Beyond Regulatory Compliance: Making Safety Second Nature*, College Station, Texas, October 24-25, 2000, pp. 228-230.

36. Krishna, K., P. Sukmarg, K.D. Kihm, W.J. Rogers and M.S. Mannan, "Droplet Size Distributions of Heat Transfer Fluid Aerosols in Air," *Proceedings of the 3rd Annual Mary Kay O'Connor Process Safety Center Symposium – Beyond Regulatory Compliance: Making Safety Second Nature*, College Station, Texas, October 24-25, 2000, pp. 392-407.
37. Landes, S.H., H.H. West, E.M. Stafford and M.S. Mannan, "Process Safeguards and Risk Analysis for Offshore Processing," *Proceedings of the 3rd Annual Mary Kay O'Connor Process Safety Center Symposium – Beyond Regulatory Compliance: Making Safety Second Nature*, College Station, Texas, October 24-25, 2000, pp. 432-447.
38. Gentile, M., W.J. Rogers and M.S. Mannan, "Application of Fuzzy Logic for the Development of an Inherent Safety Index," *Proceedings of the 3rd Annual Mary Kay O'Connor Process Safety Center Symposium – Beyond Regulatory Compliance: Making Safety Second Nature*, College Station, Texas, October 24-25, 2000, pp. 469-486.
39. Sposato, C.F., W.J. Rogers and M.S. Mannan, "Effects of Obstacle Geometry on Jet Mixing for Releases of Silane," *Proceedings of the 3rd Annual Mary Kay O'Connor Process Safety Center Symposium – Beyond Regulatory Compliance: Making Safety Second Nature*, College Station, Texas, October 24-25, 2000, pp. 500-533.
40. Mannan, M.S., "Goal Setting: A Systematic Approach to Chemical Safety Improvements," *Proceedings of the 10th International Symposium on Loss Prevention and Safety Promotion in the Process Industries*, Stockholm, Sweden, June 19-21, 2001, pp. 117-139.
41. Mannan, M.S., W.J. Rogers, A. Aldeeb, L. Cisneros, and S. Saraf, "Assessing the Potential Hazards of Reactive Chemicals," *Proceedings of the 29th North Atlantic Thermal Analysis Society Conference*, St. Louis, Missouri, September 24-26, 2001, pp. 443-448.
42. Mannan, M.S., M. Gentile, and T.M. O'Connor, "Chemical Incident Data Mining and Application to Chemical Safety Analysis," *Proceedings of the CCPS 2001 International Conference and Workshop*, Toronto, Ontario, Canada, October 2-5, 2001, pp. 137-156.
43. Cisneros, L., W.J. Rogers and M.S. Mannan, "Effect of Air in the Thermal Decomposition of 50 wt% Hydroxylamine/Water," *Proceedings of the 4th Annual Mary Kay O'Connor Process Safety Center Symposium – Beyond Regulatory Compliance: Making Safety Second Nature*, College Station, Texas, October 30-31, 2001, pp. 233-253.
44. Aldeeb, A.A., W.J. Rogers and M.S. Mannan, "Theoretical and Experimental Techniques for the Evaluation of Reactive Chemical Hazards," *Proceedings of the 4th Annual Mary Kay O'Connor Process Safety Center Symposium – Beyond Regulatory Compliance: Making Safety Second Nature*, College Station, Texas, October 30-31, 2001, pp. 268-284.
45. Saraf, S., W.J. Rogers and M.S. Mannan, "Of Computers, Chemistry, Chemical Engineering and Reactivity," *Proceedings of the 4th Annual Mary Kay O'Connor Process Safety Center Symposium – Beyond Regulatory Compliance: Making Safety Second*

Nature, College Station, Texas, October 30-31, 2001, pp. 308-320.

46. Krishna, K., T-K. Kim, K.D. Kihm, W.J. Rogers and M.S. Mannan, "Understanding the Formation of Heat Transfer Fluid Aerosols in Air," *Proceedings of the 4th Annual Mary Kay O'Connor Process Safety Center Symposium – Beyond Regulatory Compliance: Making Safety Second Nature*, College Station, Texas, October 30-31, 2001, pp. 384-393.
47. Gentile, M. and M.S. Mannan, "Development of an Inherent Safety Index Using Fuzzy Logic," *Proceedings of the 4th Annual Mary Kay O'Connor Process Safety Center Symposium – Beyond Regulatory Compliance: Making Safety Second Nature*, College Station, Texas, October 30-31, 2001, pp. 510-526.
48. Wang, Y., T.L. Teague, H.H. West and M.S. Mannan, "Computer-Aided Fault-Tree Synthesis for Quantitative Risk Assessments," *Proceedings of the 4th Annual Mary Kay O'Connor Process Safety Center Symposium – Beyond Regulatory Compliance: Making Safety Second Nature*, College Station, Texas, October 30-31, 2001, pp. 574-601.
49. Keren, N., H.H. West and M.S. Mannan, "Benchmarking MOC Practices in the Process Industry," *Proceedings of the 4th Annual Mary Kay O'Connor Process Safety Center Symposium – Beyond Regulatory Compliance: Making Safety Second Nature*, College Station, Texas, October 30-31, 2001, pp. 672-685.
50. Sharma, G. and M.S. Mannan, "Development of a Decision Support System for Chemical Incident Information," *Proceedings of the 4th Annual Mary Kay O'Connor Process Safety Center Symposium – Beyond Regulatory Compliance: Making Safety Second Nature*, College Station, Texas, October 30-31, 2001, pp. 687-691.
51. Zhou, Y., W.J. Rogers and M.S. Mannan, "A Sensor Fault Detection Scheme Using a Semi-Independent Process Model," *Proceedings of the 4th Annual Mary Kay O'Connor Process Safety Center Symposium – Beyond Regulatory Compliance: Making Safety Second Nature*, College Station, Texas, October 30-31, 2001, pp. 693-701.
52. Rajaraman, S. and M.S. Mannan, "Issues in Fault Diagnosis and Isolation," *Proceedings of the 4th Annual Mary Kay O'Connor Process Safety Center Symposium – Beyond Regulatory Compliance: Making Safety Second Nature*, College Station, Texas, October 30-31, 2001, pp. 703-716.
53. Keren, N., W.J. Rogers and M.S. Mannan, "Chemical Plant Safety Performance Measurements," *Proceedings of the 4th Annual Mary Kay O'Connor Process Safety Center Symposium – Beyond Regulatory Compliance: Making Safety Second Nature*, College Station, Texas, October 30-31, 2001, pp. 717-721.
54. Vidal, M., J.P. Wagner, W.J. Rogers and M.S. Mannan, "Electrostatic Hazards and Flammable Liquids," *Proceedings of the 4th Annual Mary Kay O'Connor Process Safety Center Symposium – Beyond Regulatory Compliance: Making Safety Second Nature*, College Station, Texas, October 30-31, 2001, pp. 723-734.

55. Mannan, M.S., W.J. Rogers, and A.A. Aldeeb, "A Systematic Approach to Reactive Chemicals Analysis," *Proceedings of Hazards XVI, Institution of Chemical Engineers*, Manchester, United Kingdom, November 6-8, 2001, pp. 41-58.
57. Roberts, M., W.J. Rogers, M.S. Mannan, and S.W. Ostrowski, "Prevention and Suppression of Metal Packing Fires," *Proceedings of the 5th Annual Mary Kay O'Connor Process Safety Center Symposium – Beyond Regulatory Compliance: Making Safety Second Nature*, College Station, Texas, October 29-30, 2002, pp. 123-131.
58. Gentile, M., W.J. Rogers, and M.S. Mannan, "Inherent Safety Index for Transportation of Chemicals," *Proceedings of the 5th Annual Mary Kay O'Connor Process Safety Center Symposium – Beyond Regulatory Compliance: Making Safety Second Nature*, College Station, Texas, October 29-30, 2002, pp. 225-244.
59. Keren, N., H.H. West, W.J. Rogers, J.P. Gupta, and M.S. Mannan, "Use of Failure Rate Databases and Process Safety Performance Measurements to Improve Process Safety," *Proceedings of the 5th Annual Mary Kay O'Connor Process Safety Center Symposium – Beyond Regulatory Compliance: Making Safety Second Nature*, College Station, Texas, October 29-30, 2002, pp. 281-298.
60. Krishna, K., W.J. Rogers, and M.S. Mannan, "Use of Aerosol Formation, Flammability, and Explosion Information for Heat Transfer Fluid Selection," *Proceedings of the 5th Annual Mary Kay O'Connor Process Safety Center Symposium – Beyond Regulatory Compliance: Making Safety Second Nature*, College Station, Texas, October 29-30, 2002, pp. 467-480.
61. Aldeeb, A.A., W.J. Rogers, and M.S. Mannan, "Evaluation of Styrene-Acrylonitrile Copolymerization Thermal Stability and Runaway Behavior," *Proceedings of the 5th Annual Mary Kay O'Connor Process Safety Center Symposium – Beyond Regulatory Compliance: Making Safety Second Nature*, College Station, Texas, October 29-30, 2002, pp. 575-588.
62. Saraf, S.R., W.J. Rogers, and M.S. Mannan, "Using Screening Test Data to Classify Reactive Chemical Hazards," *Proceedings of the 5th Annual Mary Kay O'Connor Process Safety Center Symposium – Beyond Regulatory Compliance: Making Safety Second Nature*, College Station, Texas, October 29-30, 2002, pp. 613-623.
63. Mannan, M.S., Y. Wang, and H.H. West, "QRA Study of an Activated Carbon Filter Safeguard System" *Proceedings of Hazards XVII, Institution of Chemical Engineers*, Manchester, United Kingdom, March 25-27, 2003, pp. 683-691.
65. Roberts, M.A., W.J. Rogers, M.S. Mannan, and S.W. Ostrowski, "Prevention and Suppression of Metal Packing Fires," *Proceedings of the 37th Annual Loss Prevention Symposium*, New Orleans, Louisiana, March 30–April 3, 2003.
66. Saraf, S.R., W.J. Rogers, and M.S. Mannan, "Challenges in Classification of Reactive

Chemicals,” *Proceedings of the 37th Annual Loss Prevention Symposium*, New Orleans, Louisiana, March 30–April 3, 2003.

67. Krishna, K., W.J. Rogers, and M.S. Mannan, “Integrating Aerosol Formation, Flammability, and Explosion Information into Selection of Heat Transfer Fluids,” *Proceedings of the 2003 Process Plant Safety Symposium*, New Orleans, Louisiana, March 30–April 3, 2003.
68. Saraf, S.R., W.J. Rogers, M.S. Mannan, G.T. Bodman, and S. Chervin, “Correlating Explosive Properties to DSC Parameters,” *Proceedings of the 31st North American Thermal Analysis Society Conference*, Albuquerque, New Mexico, September 22–24, 2003.
69. Fang, J.S., D.M. Ford, and M.S. Mannan, “Making the Business Case for Process Safety Using Value-at-Risk Concepts,” *Proceedings of the 6th Annual Mary Kay O’Connor Process Safety Center Symposium – Beyond Regulatory Compliance: Making Safety Second Nature*, College Station, Texas, October 28-29, 2003, pp. 78-100.
70. Whiteley, J.R., M.S. Mannan, and S.J. Brouillard, “Process Threat Management,” *Proceedings of the 6th Annual Mary Kay O’Connor Process Safety Center Symposium – Beyond Regulatory Compliance: Making Safety Second Nature*, College Station, Texas, October 28-29, 2003, pp. 107-115.
71. Aldeeb, A.A., W.J. Rogers, and M.S. Mannan, “Evaluation of 1,3-Butadiene Thermal Stability: Dimerization and Secondary Reactions,” *Proceedings of the 6th Annual Mary Kay O’Connor Process Safety Center Symposium – Beyond Regulatory Compliance: Making Safety Second Nature*, College Station, Texas, October 28-29, 2003, pp. 168-180.
72. Krishna, K., W.J. Rogers, S. Girimaji, and M.S. Mannan, “Designing an Experimental System to Study Flame Propagation Enhancement and Suppression in Heavy Hydrocarbon Aerosols,” *Proceedings of the 6th Annual Mary Kay O’Connor Process Safety Center Symposium – Beyond Regulatory Compliance: Making Safety Second Nature*, College Station, Texas, October 28-29, 2003, pp. 513-528.
73. Rogers, W.J., Y.-S. Liu, and M.S. Mannan, “Experimental and Computational Methods for Process Safety Research,” *Proceedings of the 3rd NRIFD Symposium*, Mitaka, Tokyo, Japan, March 10-12, 2004, pp. 55-66.
74. Mannan, M.S., W.J. Rogers, Y.-S. Liu, S.R. Saraf, and A.A. Aldeeb, “Regulatory Initiatives in the United States With Regard to Reactive Chemicals,” *Proceedings of the 11th International Symposium on Loss Prevention and Safety Promotion in the Process Industries*, Prague, Czech Republic, May 31-June 3, 2004, pp. 1287-1294.
75. Mannan, M.S., “Metody doświadczalne i obliczeniowe w badaniach bezpieczeństwa procesowego,” *Proceedings of the 3rd Polish Technical Conference*, Kazimierz, Poland, June 7-8, 2004, pp. 31-38.

76. Qiao, Y., M. Gentile, and M.S. Mannan, "Fuzzy Logic Methodology for Accident Frequency Assessment in Hazardous Materials Transportation," *Proceedings of the CCPS 19th Annual International Conference*, Orlando, Florida, June 29-July 1, 2004, pp. 215-224.
77. Wei, C., W.J. Rogers, and M.S. Mannan, "Detection of Autocatalytic Decomposition Behavior of Energetic Materials Using APTAC," *Proceedings of the 32st North American Thermal Analysis Society Conference*, Williamsburg, Virginia, October 4–6, 2004.
78. Liu, Y.-S, V.M. Ugaz, W.J. Rogers, and M.S. Mannan, "Development of a Nanocalorimeter for Material Characterization," *Proceedings of the 32st North American Thermal Analysis Society Conference*, Williamsburg, Virginia, October 4–6, 2004.
79. Wei, C., W.J. Rogers, and M.S. Mannan, "Thermal Decomposition Hazard Evaluation of Hydroxylamine Nitrate," *Proceedings of the 7th Annual Mary Kay O'Connor Process Safety Center Symposium – Beyond Regulatory Compliance: Making Safety Second Nature*, College Station, Texas, October 26-27, 2004, pp. 203-214.
80. Anand, S., N. Keren, M.J. Tretter, Y. Wang, T.M. O'Connor, and M.S. Mannan, "Harnessing Data Mining to Explore Incident Databases," *Proceedings of the 7th Annual Mary Kay O'Connor Process Safety Center Symposium – Beyond Regulatory Compliance: Making Safety Second Nature*, College Station, Texas, October 26-27, 2004, pp. 250-267.
81. Vidal, M., W. Wong, M.S. Mannan, and W.J. Rogers, "Evaluation of Lower Flammability Limits of Fuel-Air-Diluent Mixtures," *Proceedings of the 7th Annual Mary Kay O'Connor Process Safety Center Symposium – Beyond Regulatory Compliance: Making Safety Second Nature*, College Station, Texas, October 26-27, 2004, pp. 401-416.
82. Olive, C., T.M. O'Connor, and M.S. Mannan, "Relationship of Safety Culture and Process Safety," *Proceedings of the 7th Annual Mary Kay O'Connor Process Safety Center Symposium – Beyond Regulatory Compliance: Making Safety Second Nature*, College Station, Texas, October 26-27, 2004, pp. 432-444.
83. Mannan, M.S., H.H. West, N. Keren, and T.M. O'Connor, "Process Safety Issues for Small Businesses," *Proceedings of Hazards XVIII, Institution of Chemical Engineers*, Manchester, United Kingdom, November 22-25, 2004.
84. Mannan, M.S., H.H. West, K. Krishna, A.A. Aldeeb, N. Keren, S.R. Saraf, Y.-S. Liu, and M. Gentile, "The Legacy of Bhopal: The Impact Over the Last 20 Years and Future Direction," *Proceedings of International Conference on Bhopal Gas Tragedy and its Effects on Process Safety*, Indian Institute of Technology, Kanpur, India, December 1-3, 2004.
85. Mannan, M.S. and H.H. West, "Management of Change of Chemical Process Control

Systems,” *Proceedings of International Conference on Bhopal Gas Tragedy and its Effects on Process Safety*, Indian Institute of Technology, Kanpur, India, December 1-3, 2004.

86. Liu, Y.-S., V.M. Ugaz, W.J. Rogers and M.S. Mannan, “Development of a Miniature Calorimeter for Identification and Detection of Explosives and Other Energetic Compounds,” *Proceedings of the 8th Annual Mary Kay O’Connor Process Safety Center Symposium – Beyond Regulatory Compliance: Making Safety Second Nature*, College Station, Texas, October 25-26, 2005, pp. 23-31.
87. Papadaki, M., E.M. Domingo, T. Mahmud, M.S. Mannan, W.J. Rogers and C. Zhang, “Hydrogen Peroxide Runaway Reaction,” *Proceedings of the 8th Annual Mary Kay O’Connor Process Safety Center Symposium – Beyond Regulatory Compliance: Making Safety Second Nature*, College Station, Texas, October 25-26, 2005, pp. 72-83.
88. Leake, J., D. Furry, A. Murthi and M.S. Mannan, “Application of Photographic Visualization and Thermal Detection Techniques for Non-Intrusive Imaging of LNG Leaks and Plumes,” *Proceedings of the 8th Annual Mary Kay O’Connor Process Safety Center Symposium – Beyond Regulatory Compliance: Making Safety Second Nature*, College Station, Texas, October 25-26, 2005, pp. 164-182.
89. Kim, K., K. Park, M.S. Mannan and E.S. Yoon, “Safety Analysis of LNG Terminal Focused on the Consequence Calculation of Accidental and Intentional Spills,” *Proceedings of the 8th Annual Mary Kay O’Connor Process Safety Center Symposium – Beyond Regulatory Compliance: Making Safety Second Nature*, College Station, Texas, October 25-26, 2005, pp. 200-218.
90. Raghunathan, V., S. Anand, H.H. West, Y. Wang, M. Sawyer and M.S. Mannan, “Spill Modeling of Dilute Water Stream Solutions,” *Proceedings of the 8th Annual Mary Kay O’Connor Process Safety Center Symposium – Beyond Regulatory Compliance: Making Safety Second Nature*, College Station, Texas, October 25-26, 2005, pp. 400-410.
91. Whipple, T., R. Coates, M. Wisby, K. Richardson, A. Murthi, H.H. West and M.S. Mannan, “Design of Experiments for LNG Spills on Land,” *Proceedings of the 8th Annual Mary Kay O’Connor Process Safety Center Symposium – Beyond Regulatory Compliance: Making Safety Second Nature*, College Station, Texas, October 25-26, 2005, pp. 543-554.
92. Wise, M.S., A. Murthi, H.H. West and M.S. Mannan, “Multiple Agent Suppression Characteristics in Fires Involving Cryogenic Fuel Groups,” *Proceedings of the 8th Annual Mary Kay O’Connor Process Safety Center Symposium – Beyond Regulatory Compliance: Making Safety Second Nature*, College Station, Texas, October 25-26, 2005, pp. 555-578.
93. Mannan, M.S., Y. Wang, C. Zhang, and H.H. West, “Application of Inherently Safer Design Principles in Biodiesel Production Process,” *Proceedings of Hazards XIX*,

Resume for M. Sam Mannan, PhD, PE, CSP

Institution of Chemical Engineers, Manchester, United Kingdom, March 28-30, 2006, pp. 982-989.

94. Suardin, J.A., and M.S. Mannan, "The Integration of Dow's Fire and Explosion Index into Process Design and Optimization to Achieve Inherently Safer Design," *Proceedings of the CCPS 2006 International Conference and Workshop*, Orlando, Florida, April 23-27, 2006.
95. Markowski, A.S., and M.S. Mannan, "Fuzzy Logic Application for LOPA," *Proceedings of the 5th European Meeting on Chemistry and Environment*, Vienna, Austria, May 3-5, 2006, pp. 1015-1028.
96. Mannan, M.S., A.S. Markowski, Y. Wang, J.A. Suardin, and H.H. West, "Safety and Environmental Issues in the Alkylation Process," *Proceedings of the 5th European Meeting on Chemistry and Environment*, Vienna, Austria, May 3-5, 2006, pp. 1029-1037.
97. Markowski, A.S., and M.S. Mannan, "Development of the Incident Scenario for LOPA," *Proceedings of the 5th European Meeting on Chemistry and Environment*, Vienna, Austria, May 3-5, 2006, pp. 1038-1046.
98. Markowski, A.S., and M.S. Mannan, "Analiza Warstw Zabezpieczeń (AWZ-LOPA)," *Proceedings of the 5th Scientific Technical Conference – Technical Safety in the Chemical Industry*, Sobieszewo k. Gdańska, Poland, May 16-17, 2006, pp. 19-26.
99. West, H.H., M.S. Mannan, and A.S. Markowski, "Nowe Zagadnienia z Dziedziny Technologii Skroplonego Gazu Ziemnego," *Proceedings of the 5th Scientific Technical Conference – Technical Safety in the Chemical Industry*, Sobieszewo k. Gdańska, Poland, May 16-17, 2006, pp. 27-34.
100. Mannan, M.S., and A.S. Markowski, "Wykorzystywanie Baz Danych Wypadków do Pomiaru i Poprawy Bezpieczeństwa," *Proceedings of the 5th Scientific Technical Conference – Technical Safety in the Chemical Industry*, Sobieszewo k. Gdańska, Poland, May 16-17, 2006, pp. 35-43.
101. Nelson, I.C., D. Banerjee, W.J. Rogers and M.S. Mannan, "Detection of Explosives Using Heated Microcantilever Sensor," *Proceedings of the SPIE*, vol. 6223, [2006].
102. Mannan, M.S., H.H. West, and P.C. Berwanger, "Lessons Learned from Recent Incidents: Facility Siting, Atmospheric Venting, and Operator Information Systems," *Proceedings of the 6th International Symposium on Hazards, Prevention, and Mitigation of Industrial Explosions*, vol. III, Dalhousie University, Halifax, NS, Canada, Aug 27 – Sep 1, 2006, pp. 733-744.
103. Wei, C., W.J. Rogers and M.S. Mannan, "Layer of Protection Analysis for Reactive Chemical Risk Assessment," *Proceedings of the 9th Annual Mary Kay O'Connor Process Safety Center Symposium – Beyond Regulatory Compliance: Making Safety Second Nature*, College Station, Texas, October 24-25, 2006, pp. 60-71.

104. Papadaki, M., P. Stathi, W.J. Rogers and M.S. Mannan, "Preliminary Studies of Hydroxylamine Isothermal Decomposition," *Proceedings of the 9th Annual Mary Kay O'Connor Process Safety Center Symposium – Beyond Regulatory Compliance: Making Safety Second Nature*, College Station, Texas, October 24-25, 2006, pp. 72-78.
105. Mitchell, S.M. and M.S. Mannan, "Beyond Guns, Guards, and Gates: A Holistic Approach to Critical Infrastructure Protection," *Proceedings of the 9th Annual Mary Kay O'Connor Process Safety Center Symposium – Beyond Regulatory Compliance: Making Safety Second Nature*, College Station, Texas, October 24-25, 2006, pp. 424-439.
106. Markowski, A.S. and M.S. Mannan, "Fuzzy Risk Matrix," *Proceedings of the 9th Annual Mary Kay O'Connor Process Safety Center Symposium – Beyond Regulatory Compliance: Making Safety Second Nature*, College Station, Texas, October 24-25, 2006, pp. 440-449.
107. Cormier, B., Y. Wang, M. Moore, H.H. West, and M.S. Mannan, "LNG Mitigation Experiments – Preliminary Results," *Proceedings of the 9th Annual Mary Kay O'Connor Process Safety Center Symposium – Beyond Regulatory Compliance: Making Safety Second Nature*, College Station, Texas, October 24-25, 2006, pp. 450-467.
108. Mitchell, S.M. and M.S. Mannan, "Resilient Engineered Systems: Pipe Design," *Proceedings of the 9th Annual Mary Kay O'Connor Process Safety Center Symposium – Beyond Regulatory Compliance: Making Safety Second Nature*, College Station, Texas, October 24-25, 2006, pp. 548-558.
109. Narayanan, D., R. Talreja, C. Ehlig-Economides, H.H. West, and M.S. Mannan "Engineering for Sustainable Development – Application of Analytical Approach and Metrics on a Bio-Diesel Plant," *Proceedings of the 9th Annual Mary Kay O'Connor Process Safety Center Symposium – Beyond Regulatory Compliance: Making Safety Second Nature*, College Station, Texas, October 24-25, 2006, pp. 559-563.
110. Markowski, A.S. and M.S. Mannan, "Fuzzy Logic for Piping Risk Assessment (pfLOPA)," *Proceedings of the World Congress of Safety of Oil and Gas Industry*, Hotel Hyundai, Gyeongju, Korea, April 10-13, 2007, pp. 182-186.
111. Mannan, M.S., M. Meneses, Y. Zhang and Y. Wang, "Our Inability to Learn From the Past: Is Buncefield Another Example?" *Proceedings of the 12th International Symposium on Loss Prevention and Safety Promotion in the Process Industries*, Edinburgh, United Kingdom, May 22-24, 2007.
112. Liu, L., W.J. Rogers, M.S. Mannan, M. Papadaki, E. Pontiki and P. Stathi, "Isothermal Decomposition of Hydroxylamine and Hydroxylamine Nitrate in Aqueous Solutions in the Temperature Range 353-433 K," *Proceedings of the 42nd Annual Loss Prevention Symposium*, New Orleans, Louisiana, April 7-9, 2008, pp. 166-174.

113. Rana, M., B.R. Cormier, J.A. Suardin, Y. Zhang and M.S. Mannan, "Experimental Study of Effective Water Spray Curtain Application in Dispersing LNG Vapor Clouds," *Proceedings of the 42nd Annual Loss Prevention Symposium*, New Orleans, Louisiana, April 7–9, 2008, pp. 341-362.
114. Mannan, M.S., D. Narayanan, and Y. Guo, "What Do We Want to Sustain and How Do We Decide?" *Proceedings of Hazards XX, Institution of Chemical Engineers*, Manchester, United Kingdom, April 14-17, 2008, pp. 154-169.
115. Vázquez-Román, R., J.-H. Lee, S. Jung, and M.S. Mannan, "Designing Plant Layouts with Toxic Releases Based on Wind Statistics," *Proceedings of 19th IASTED International Conference on Modelling and Simulation*, Quebec City, Quebec, Canada, May 26-28, 2008.
116. Waldram, S.P., S. Partington, and M.S. Mannan, "Loss of Control and Reactor Rupture During a Runaway Reaction Whilst Producing an Azo Dye Intermediate," *Proceedings of 1st Latin American Process Safety Conference*, Buenos Aires, Argentina, May 27-29, 2008.
117. Diaz-Ovalle, C.O., S. Jung, R. Vázquez-Román, and M.S. Mannan, "An Approach to Solve the Facility Layout Problem Based on the Worst Scenario," *Proceedings of the 11th Annual Mary Kay O'Connor Process Safety Center Symposium – Beyond Regulatory Compliance: Making Safety Second Nature*, College Station, Texas, October 28-29, 2008, pp. 28-39.
118. Saenz, L., V. Carreto-Vazquez, L.Liu, W.J. Rogers, and M.S. Mannan, "2-Methylpyridine N-Oxidation Runaway Studies," *Proceedings of the 11th Annual Mary Kay O'Connor Process Safety Center Symposium – Beyond Regulatory Compliance: Making Safety Second Nature*, College Station, Texas, October 28-29, 2008, pp. 182-196.
119. Papadaki, M., E. Pontiki, L. Liu, W.J. Rogers, and M.S. Mannan, "Thermal Behavior of Aqueous Solutions of Hydroxylamine During Isothermal Decomposition in a Closed System," *Proceedings of the 11th Annual Mary Kay O'Connor Process Safety Center Symposium – Beyond Regulatory Compliance: Making Safety Second Nature*, College Station, Texas, October 28-29, 2008, pp. 265-272.
120. Markowski, A.S., M.S. Mannan, A. Bigoszevska and D. Siuta, "Uncertainty Aspects in Process Hazard Analysis," *Proceedings of the 11th Annual Mary Kay O'Connor Process Safety Center Symposium – Beyond Regulatory Compliance: Making Safety Second Nature*, College Station, Texas, October 28-29, 2008, pp. 309-323.
121. Safitri, A., and M.S. Mannan, "Infrared Imaging System for Detection and Concentration Measurement of Fugitive Natural Gas Leak," *Proceedings of the 11th Annual Mary Kay O'Connor Process Safety Center Symposium – Beyond Regulatory Compliance: Making Safety Second Nature*, College Station, Texas, October 28-29,

2008, pp. 345-354.

122. Rana, M.A., B.R. Cormier, J.A. Suardin, and M.S. Mannan, "LNG Vapor Cloud Dispersion With Water Spray Curtain," *Proceedings of the 11th Annual Mary Kay O'Connor Process Safety Center Symposium – Beyond Regulatory Compliance: Making Safety Second Nature*, College Station, Texas, October 28-29, 2008, pp. 538-556.
123. Saenz, L.R., W.J. Rogers, M.S. Mannan, and M. Papadaki, "Approach for the Development of a More Efficient and Safer Process in the Pharmaceutical Industry," *Proceedings of the 43th Annual Loss Prevention Symposium*, Tampa, Florida, April 26-30, 2009, pp. 1-14.
124. Diaz-Ovalle, C.O., R. Vázquez-Román, S. Jung, and M.S. Mannan, "A Comparison of Deterministic and Stochastic Approaches to Solve the Facility Layout Problem with Toxic Releases," *Proceedings of the 19th European Symposium on Computer Aided Process Engineering – ESCAPE19*, eds. J. Jeżowski and J. Thullie, Cracow, Poland, June 14-17, 2009, pp. 93-98.
125. Markowski, A.S. and M.S. Mannan, "ExSys-LOPA for the Chemical Process Industry," *Proceedings of the 12th Annual Mary Kay O'Connor Process Safety Center Symposium – Beyond Regulatory Compliance: Making Safety Second Nature*, College Station, Texas, October 27-28, 2009, pp. 5-19.
126. Saenz, L.R., W.J. Rogers, M.S. Mannan and M. Papadaki, "Secondary Decompositions in the N-Oxidation of Low-order Alkylpyridines," *Proceedings of the 12th Annual Mary Kay O'Connor Process Safety Center Symposium – Beyond Regulatory Compliance: Making Safety Second Nature*, College Station, Texas, October 27-28, 2009, pp. 203-214.
127. Herrera, C., R.A. Mentzer and M.S. Mannan, "Absorption Characteristic of Liquefied Natural Gas (LNG) as a Function of Infrared (IR) Wavelength," *Proceedings of the 12th Annual Mary Kay O'Connor Process Safety Center Symposium – Beyond Regulatory Compliance: Making Safety Second Nature*, College Station, Texas, October 27-28, 2009, pp. 316-323.
128. Rana, M. and M.S. Mannan, "Forced Dispersion of LNG Vapor with Water Curtain," *Proceedings of the 12th Annual Mary Kay O'Connor Process Safety Center Symposium – Beyond Regulatory Compliance: Making Safety Second Nature*, College Station, Texas, October 27-28, 2009, pp. 338-347.
129. Qi, R., S.P. Waldram and M.S. Mannan, "Modeling Vapor Dispersion in an LNG Spill Test with CFD," *Proceedings of the 12th Annual Mary Kay O'Connor Process Safety Center Symposium – Beyond Regulatory Compliance: Making Safety Second Nature*, College Station, Texas, October 27-28, 2009, pp. 363-372.
130. Waldram, S.P. and M.S. Mannan, "Teaching Process Safety: A Stand-Alone

Resume for M. Sam Mannan, PhD, PE, CSP

- Course or a Continuous Integrating Thread Throughout a Chemical Engineering Degree,” *Proceedings of the 12th Annual Mary Kay O’Connor Process Safety Center Symposium – Beyond Regulatory Compliance: Making Safety Second Nature*, College Station, Texas, October 27-28, 2009, pp. 448-455.
131. Jung, S., D. Ng, H. Pasman, C. Laird and M.S. Mannan, “A New Approach for Facility Siting Using Mapping Risks on the Plant and Grid Selection Optimization,” *Proceedings of the 12th Annual Mary Kay O’Connor Process Safety Center Symposium – Beyond Regulatory Compliance: Making Safety Second Nature*, College Station, Texas, October 27-28, 2009, pp. 562-572.
 132. Castellanos, D., D. Ng, V.H. Carreto-Vazquez, H.J. Pasman and M.S. Mannan, “Review of an Adequate Chemical Dust Suppressant Used for Prevention of Dust Explosions in Food Industry,” *Proceedings of the 12th Annual Mary Kay O’Connor Process Safety Center Symposium – Beyond Regulatory Compliance: Making Safety Second Nature*, College Station, Texas, October 27-28, 2009, pp. 697-701.
 133. Ryder, N.L., C.F. Schemel and M.S. Mannan, “Analysis of the Buncefield Oil Depot Explosion: Explosion Modeling and Process Safety Perspective,” *Proceedings of the 12th Annual Mary Kay O’Connor Process Safety Center Symposium – Beyond Regulatory Compliance: Making Safety Second Nature*, College Station, Texas, October 27-28, 2009, pp. 774-783.
 134. Yang, X., L. Dinh, D. Castellanos, C. Osorio, D. Ng and M.S. Mannan, “Common Lessons Learned From an Analysis of Multiple Case Histories,” *Proceedings of HAZARDS XXI, Institution of Chemical Engineers*, Manchester, UK, November 9-12, 2009, pp. 43-50.
 135. Mannan, M.S., T. Olewski, and S.P. Waldram, “Safety in the Oil and Gas Industries in Qatar,” *Proceedings of HAZARDS XXI, Institution of Chemical Engineers*, Manchester, UK, November 9-12, 2009, pp. 570-575.
 136. Mannan, M.S., “A Technical Analysis of the Buncefield Explosion and Fire,” *Proceedings of HAZARDS XXI, Institution of Chemical Engineers*, Manchester, UK, November 9-12, 2009, pp. 662-673.
 137. Lu, Y., D. Ng, and M.S. Mannan, “Prediction of the reactivity hazards for organic peroxides using QSPR approach,” *Proceedings of 6th Global Congress on Process Safety*, San Antonio, Texas, March 21-25, 2010.
 138. Jung, S., D. Ng, C. Laird, and M.S. Mannan, “Optimizing Facility Siting and Layout through Mapping Risk Estimates on Plant Area and Monetizing,” *Proceedings of 6th Global Congress on Process Safety*, San Antonio, Texas, March 21-25, 2010.
 139. Mannan, M.S., K.P. Prem and Dedy Ng, “Challenges and Needs for Process Safety in the New Millenium,” *Proceedings of 13th International Symposium on Loss*

Prevention and Safety Promotion in the Process Industries, Brugge, Belgium, June 6-9, 2010, pp. 5-13.

140. Rana, M.A., R. Qi, G. Yun, D. Ng and M.S. Mannan, "Recent Advances in LNG Field Experiments and Modeling of LNG Release and Mitigation Scenarios," *Proceedings of 13th International Symposium on Loss Prevention and Safety Promotion in the Process Industries*, Brugge, Belgium, June 6-9, 2010, pp. 57-64.
141. Qi, R., O. Basha, M.S. Mannan, T. Olewski and S.P. Waldram, "Medium-Scale LNG Experiments at Brayton Fire Training Field, Texas and Their Relationship to Process Safety in the LNG Industries in Qatar," *Proceedings of 13th International Symposium on Loss Prevention and Safety Promotion in the Process Industries*, Brugge, Belgium, June 6-9, 2010, pp. 65-72.
142. Jung, S., D. Ng, H.J. Pasman and M.S. Mannan, "A New Approach to Optimizing Facility Layout by Mapping Risk Estimates on Plant Area, Monetizing and Minimizing," *Proceedings of 13th International Symposium on Loss Prevention and Safety Promotion in the Process Industries*, Brugge, Belgium, June 6-9, 2010, pp. 113-120.
143. Markowski, A.S., R.E. Sanders and M.S. Mannan, "Using Layers of Protection Analysis: The Do's and the Views," *Proceedings of the 13th Annual Mary Kay O'Connor Process Safety Center Symposium – Beyond Regulatory Compliance: Making Safety Second Nature*, College Station, Texas, October 26-28, 2010, pp. 90-106.
144. Markowski, A.S., M.S. Mannan and A. Kotynia, "Application of fuzzy logic to explosion risk assessment," *Proceedings of the 13th Annual Mary Kay O'Connor Process Safety Center Symposium – Beyond Regulatory Compliance: Making Safety Second Nature*, College Station, Texas, October 26-28, 2010, pp. 181-203.
145. Saenz, L., S. Nayak, M.S. Mannan, M. Papadaki and S.P. Waldram, "A New approach to Optimizing the Facility Siting and Layout for Fire and Explosion Scenarios," *Proceedings of the 13th Annual Mary Kay O'Connor Process Safety Center Symposium – Beyond Regulatory Compliance: Making Safety Second Nature*, College Station, Texas, October 26-28, 2010, pp. 376-385.
146. Prem, K.P., D. Ng and M.S. Mannan, "Decision Theory: Why It Is Important for Improving Chemical Process Safety," *Proceedings of the 13th Annual Mary Kay O'Connor Process Safety Center Symposium – Beyond Regulatory Compliance: Making Safety Second Nature*, College Station, Texas, October 26-28, 2010, pp. 708-714.
147. Wang, Q. and M.S. Mannan, "Stretch in Technology and Keeping the Focus on Process Safety for Exploration and Production in the 21st Century," *Proceedings of the 13th Annual Mary Kay O'Connor Process Safety Center Symposium – Beyond Regulatory Compliance: Making Safety Second Nature*, College Station, Texas, October 26-28, 2010, pp. 717-722.

148. Jung, S., D. Ng, C. Diaz-Ovalle, R. Vazquez-Roman and M.S. Mannan, "A New approach to Optimizing the Facility Siting and Layout for Fire and Explosion Scenarios," *Proceedings of the 13th Annual Mary Kay O'Connor Process Safety Center Symposium – Beyond Regulatory Compliance: Making Safety Second Nature*, College Station, Texas, October 26-28, 2010, pp. 747-763.
149. Hansen, O.R., S. Davis and M.S. Mannan, "Assessing the Credibility of Major Incidents During a Process Hazards Analysis," *Proceedings of the 13th Annual Mary Kay O'Connor Process Safety Center Symposium – Beyond Regulatory Compliance: Making Safety Second Nature*, College Station, Texas, October 26-28, 2010, pp. 808-816.
150. Valenzuela, E.M., R. Vázquez-Román, S.J. Patel and M.S. Mannan, "Prediction Models for the Flash point of Pure Components," *Proceedings of the 13th Annual Mary Kay O'Connor Process Safety Center Symposium – Beyond Regulatory Compliance: Making Safety Second Nature*, College Station, Texas, October 26-28, 2010, pp. 824-834.
151. Herrera, C., R.A. Mentzer, M.S. Mannan and S.P. Waldram, "Calculation of Liquefied Natural Gas (LNG) Burning Rates," *Proceedings of the 13th Annual Mary Kay O'Connor Process Safety Center Symposium – Beyond Regulatory Compliance: Making Safety Second Nature*, College Station, Texas, October 26-28, 2010, pp. 1034-1041.

MAJOR REPORTS

1. "Development of a Thermodynamic Properties Correlation Framework for the Coal Conversion Industry", project final report prepared for and submitted to the Department of Energy, Pittsburgh Energy Technology Center, August, 1983 (with K.E. Starling et al).
2. "Study of Phase Equilibria of Nitrogen with Reservoir Fluids", project final report prepared for and submitted to INTEVEP June 1984 (with S. Watanasiri, K.H. Kumar and K.E. Starling).
3. "Thermophysical Properties Correlations and Pseudocomponent Characterization Parameter Estimation for Fossil Fluids", project final report prepared for and submitted to the Department of Energy, Pittsburgh Energy Technology Center, August, 1986 (with K.E. Starling et al).
4. "Development of an Equation of State for Computation of Supercompressibility Factors, Critical Flow Factors, and Other Properties for Wet, Sour Natural Gases, Synthetic Gases and Admixtures, project final report prepared for and submitted to the Gas Research Institute, GRI-88/0001, September, 1987 (with K. E. Starling, et al).
5. "Evaluation and Correlation of Flange Tapped Orifice Discharge Coefficient Data", project final report prepared for and submitted to the Gas Research Institute, Contract No. 5087-271-1477, January 1988 (with K. E. Starling and K. R. Sheth).

Resume for M. Sam Mannan, PhD, PE, CSP

6. "Highly Accurate Compressibility Factor Equation for Natural Gases", project final report prepared for and submitted to the Gas Research Institute, Contract No. 5089-260-1886, October, 1990 (with K. E. Starling and M. A. Khan).
7. "Year 2000 Issues: Technology Problems and Industrial Chemical Safety," Report to the US Senate Special Committee on the Year 2000 Technology Problem, prepared under contract with the US Chemical Safety and Hazard Investigation Board, March 1999.
8. "National Chemical Safety Assessment Report – 2001," Mary Kay O'Connor Process Safety Center, College Station, Texas, April 2002.
9. "Challenges in Implementing Inherent Safety Principles in New and Existing Chemical Processes," White Paper, Mary Kay O'Connor Process Safety Center, College Station, Texas, August 2002.
10. "Challenges of Regulating or Implementing a Reactive Chemicals Hazard Management Program," Comments provided to the United States Chemical Safety and Hazard Investigation Board, Reactive Chemicals Public Hearing, Houston, Texas, September 17, 2002.
11. "Prevention and Suppression of Metal Packing Fires," Mary Kay O'Connor Process Safety Center, College Station, August 2003.
12. "LNG Pool Fire Modeling," White Paper, Mary Kay O'Connor Process Safety Center, College Station, Texas, September 2008.

TECHNICAL MEETING PRESENTATIONS

1. "Characterization Methods for Systems Containing Many Components for Use in Phase Equilibrium and Thermophysical Properties Calculations", presented at the American Institute of Chemical Engineers 1984 Winter National Meeting at Atlanta, Georgia, March 11-14, 1984 (with S. Watanasiri, K. H. Kumar, and K. E. Starling).
2. "Development of an Uncertainty Statement for Each Datapoint in the Calculated Database", presented at the API/GPA/NBS Orifice Metering Seminar at the National Bureau of Standards, Gaithersburg, Maryland, September 23, 1986 (with K. E. Starling).
3. "Evaluation of A.G.A. Report No. 8 for Rich Gas Compressibility Factor Calculations", proceedings of the Sixty-Sixth Annual GPA Convention, Denver, Colorado, March 16-18, 1987 (with K. E. Starling and J. L. Savidge).
4. "New Strides Toward More Accurate Volumetric Measurement", presented at the Institute of Gas Technology Symposium on Natural Gas Energy Measurement, Chicago, Illinois, June 27, 1988 (with K. E. Starling).

Resume for M. Sam Mannan, PhD, PE, CSP

5. "Evaluation of a High Accuracy Equation-of-State for Gas Phase Mixture Compressibility Factors", presented at the Fourth Pacific Area Chemical Engineering Congress in Acapulco, Mexico, October 19-23, 1988 (with K. E. Starling).
6. "Improvement in Compressibility Factor Predictions for Orifice Meter Calculations", presented at the 1989 Gas Gathering and Processing Workshop sponsored by the University of Oklahoma Energy Center and the Gas Research Institute, Norman, Oklahoma, May 9-10, 1989.
7. "Fundamentals of Gas Measurement - IV", with K. E. Starling, presented at the 64th International School of Hydrocarbon Measurement, Norman, Oklahoma, May 16-18, 1989.
8. "Energy Analysis of Integrated Energy Systems: Natural Gas-Fired Combined Cycle Power Plant", presented at the 9th Miami International Congress on Energy and Environment, December 11-13, 1989, Miami Beach, Florida.
9. "Thermodynamic Properties for Natural Gas Flow Measurement", International Symposium on Fluid Flow Measurement, AGA, Arlington, VA, May 1990 (with K. E. Starling, M. A. Khan and J. L. Savidge).
10. "Safety Engineering for Sour Gas Pipelines", paper presented at the PETRO-SAFE 1991 Conference, Houston, Texas, February 6-8, 1991 (with D. Pfenning and D. Zinn).
11. "Overview of OSHA's Process Safety Management Rule and its Effect on the High Technology Industry," paper presented at the Semiconductor Safety Association Hill Country Conference, Austin, Texas, February 11-12, 1993.
12. "Impact of OSHA's Process Safety Management and Confined Space Regulations on Aboveground Storage Tank Facilities," paper presented at the 4th Annual Aboveground Tank Conference, Houston, Texas, June 8-9, 1993 (with V.J. Bily).
13. "Management of Change: Process Safety Management Practice," paper presented at the 1994 AIChE Spring National Meeting, Atlanta, GA, April 18-20, 1994 (with R. Danna and H. West).
14. "Synergistic Development of PHA's for Compliance With EPA's Risk Management Program and OSHA's PSM Rules," paper presented at the 1994 TCC/ACIT Safety Seminar, Galveston, Texas, June 6-9, 1994.
15. "Impact of EPA's Proposed Risk Management Program Rule On the Ammonia/Fertilizer Industry," paper presented at the 1995 Gulf Coast Ammonia Producers Conference, Baton Rouge, Louisiana, April 10-12, 1995.
16. "Revalidation of PHA's," paper presented at the 1995 TCC/ACIT Safety Seminar, Galveston, Texas, June 5-8, 1995.

Resume for M. Sam Mannan, PhD, PE, CSP

17. "EPA's Risk Management Program Regulation and It's Impact on Industry in the Midwestern United States," paper presented at the Environment 96 Conference sponsored by the Federation of Environmental Technologists, Milwaukee, Wisconsin, March 5-6, 1996.
18. "Process Risk Management," paper presented at the 1996 Environmental Audit Roundtable, Memphis, Tennessee, May 7, 1996.
19. "Impact of EPA's Risk Management Program Rule and OSHA's PSM Program Rule on Foundries," paper prepared for presentation at the 1997 American Foundrymen's Society Training Course, Des Plaines, Illinois, March 25-27, 1997 (with J. Radia).
20. "PSM, RMP, SEMP, and API RP 75," Keynote speaker, Occupational Safety Congress and Exhibition, Acadiana Safety Association, National Safety Council, Lafayette, Louisiana, October 1-2, 1997.
21. "Research Programs at the Mary Kay O'Connor Process Safety Center," presentation to the Chemical Manufacturers Association, Washington, DC, October 28, 1997.
22. "Collaborative Efforts Between the Mary Kay O'Connor Process Safety Center and the USEPA," presentation to the US Environmental Protection Agency, Washington, DC, January 6, 1998.
23. "Collaborative Efforts Between the Mary Kay O'Connor Process Safety Center and the Dow Chemical Company," presentation to the Dow Chemical Company, Freeport, TX, January 14, 1998.
24. "The Role of the Chemical Safety & Hazard Investigation Board," Keynote Speaker, PSM/RMP Open Forum, Albany, Georgia, January 15, 1998.
25. "New Challenges in Chemical Engineering: Integrating Process Safety into Chemical Engineering Education and Research," 1998 Annual Symposium of the Mary Kay O'Connor Process Safety Center, March 30-31, 1998, College Station, Texas.
26. "Accident History Database: An Opportunity," 1998 Annual Symposium of the Mary Kay O'Connor Process Safety Center, March 30-31, 1998, College Station, Texas.
27. "Data Required for Predicting Reactive Chemical Pathways," 1998 Annual Symposium of the Mary Kay O'Connor Process Safety Center, March 30-31, 1998, College Station, Texas.
28. "Stakeholders Must Work Together to Accomplish the Objectives of the Risk Management Program," The Fourteenth International Hazardous Materials Spills Conference, April 5-9, 1998, Chicago, Illinois.
29. "Risk Communication and the Role of the Chemical Safety & Hazard Investigation Board," Keynote Speaker, PSM/RMP Open Forum, Cleveland, Ohio, April 21, 1998.

30. "Risk Communication and Community Relations," paper presented at the 1998 TCC/ACIT Safety Seminar, The Woodlands, Texas, June 8-11, 1998.
31. "Basic Research Needs in Process Safety," paper presented at the 1998 Process Plant Safety Symposium, Sheraton Astrodome Hotel, Houston, October 26-27, 1998.
32. "Dense Gas Modeling for Aqueous Releases," paper presented at the 1998 Process Plant Safety Symposium, Sheraton Astrodome Hotel, Houston, October 26-27, 1998 (presented by A. Lara, graduate student).
33. "Source Term Modeling for High Pressure, High Temperature Releases of High Viscosity Fluids," paper presented at the 1998 Process Plant Safety Symposium, Sheraton Astrodome Hotel, Houston, October 26-27, 1998 (presented by I. Shaikh, graduate student).
34. "Experiences with Management of Change Systems," paper presented at the 1998 Process Plant Safety Symposium, Sheraton Astrodome Hotel, Houston, October 26-27, 1998.
35. "If you Model It, Will They Come?" paper presented at the 1998 Process Plant Safety Symposium, Sheraton Astrodome Hotel, Houston, October 26-27, 1998.
36. "The Use of Risk Management Plan Information by Local Emergency Response Organizations," paper presented at the OECD Workshop on *New Developments in Chemical Emergency Preparedness and Response*, Lappeenranta, Finland, November 3-6, 1998.
37. "Pollution Prevention in Design," paper presented at the Second Pollution Prevention Conference, American Institute of Chemical Engineers, March 18-19, 1999, Houston, Texas.
38. "The Y2K Problem and Its Impact on the Trucking Industry," paper presented at the Annual Meeting of the Texas Tank Truck Carriers Association, Sheraton Astrodome Hotel, Houston, Texas, April 29, 1999.
39. "Federal Guidelines and Safety Education," Keynote Address at the 1999 SACHE FACULTY WORKSHOP ON PROCESS SAFETY, May 18, 1999, Freeport, Texas.
41. "Process Safety Engineering Tools for Design Engineers," paper presented at the 1999 Kellogg Brown and Root HSE Conference, Hyatt Regency Hotel, Houston, Texas, September 8, 1999.
42. "Y2K, Chemical Safety, and Emergency Planning," paper presented at the OES Contingency Planning Conference, Sacramento, CA, September 9, 1999.

Resume for M. Sam Mannan, PhD, PE, CSP

43. "National Chemical Safety Goals For a New Millenium," paper presented at the PPP2000 Conference - *When Natural and Industrial Disasters Collide*, Washington, DC – October 13, 1999.
44. "Impact of Chemical Safety Advances on the Process Control and Instrumentation Industry," Keynote Address at the 1999 Triconex Users Group Meeting, November 2, 1999, Galveston, Texas.
46. "Quantitative Risk Assessment Study of a Liquefied Oxygen Reactor Feed System," paper presented at the 2000 AIChE Spring National Meeting, Atlanta, GA, March 5-9, 2000.
47. "Chemical Safety Trend Analyses," paper presented at the 2001 AIChE Spring National Meeting, Houston, TX, April 23-25, 2001.
48. "LNG Safety Practice & Regulations: From the 1944 East Ohio Tragedy to Today's Excellent Safety Record," paper presented at the 2001 AIChE Spring National Meeting, Houston, TX, April 23-25, 2001.
49. "SEGURIDAD INTRÍNSECA: un enfoque opuesto a la seguridad tradicional," paper presented at the 2001 IMIQ National Convention, October 3-5, 2001, Puebla, Mexico (presented by M. Gentile, graduate student).
50. "Development of an Inherent Safety Index Based on Fuzzy Logic," paper presented at the 2001 AIChE Annual Meeting, November 5-9, 2001, Reno, Nevada (presented by M. Gentile, graduate student).
51. "Thermal Decomposition Studies of Hydroxylamine Compounds," paper presented at the 2001 AIChE Annual Meeting, November 5-9, 2001, Reno, Nevada (presented by L.O. Cisneros, graduate student).
52. "Density Functional Investigation of Hydroxylamine Decomposition," paper presented at the 2001 AIChE Annual Meeting, November 5-9, 2001, Reno, Nevada (presented by S. Saraf, graduate student).
53. "Computational Chemistry and Molecular Simulation for Engineers: A Cooperative Effort across College Boundaries," paper presented at the 2001 AIChE Annual Meeting, November 5-9, 2001, Reno, Nevada (presented by D.M. Ford).
54. "Understanding the Role of Process Chemistry in Fires and Explosions," paper presented at the 36th Annual Loss Prevention Symposium, AIChE Meeting, March 10-14, 2002, New Orleans, Louisiana (presented by A.A. Aldeeb, graduate student).
55. "Calorimetric Studies of Hydroxylamine and Related Compounds," paper presented at the 1st International Congress on the Process Industries, AchemAmerica 2002, March 18-20, 2002, Mexico City, Mexico (presented by L.O. Cisneros, graduate student).

56. "Calorimetric Data Correlations Using Molecular Descriptors," paper presented at the 2002 AIChE Annual Meeting, November 4-8, 2002, Indianapolis, Indiana (presented by S.R. Saraf, graduate student).
57. "Analyzing Reaction Pathways for Evaluation of Reactive Hazards," paper presented at the 2002 AIChE Annual Meeting, November 4-8, 2002, Indianapolis, Indiana (presented by A.A. Aldeeb, graduate student).
58. "Learning from RMP Accident History," paper presented at the Risk Center Roundtable, Wharton Risk Management & Decision Processes Center, University of Pennsylvania, March 4, 2003, Philadelphia, Pennsylvania.
59. "Lessons Learned from a Catastrophic Control Valve Failure," paper presented at the ISA Safety Division Symposium, March 20, 2003, Houston, Texas.
60. "Refrigerant System Control Valve Failure," paper presented at the AIChE Spring National Meeting, 3rd Topical Conference on Natural Gas Utilization, April 2, 2003, New Orleans, Louisiana.
61. "Chemical Incident Data Mining and Application to Chemical Safety Analysis," paper presented at the Centers for Disease Control, Hazardous Substances Emergency Events Surveillance Meeting, May 8, 2003, Atlanta, Georgia.
62. "Challenges of Regulating or Implementing a Reactive Chemicals Hazard Management Program," paper presented at the 2003 American Industrial Hygiene Conference & Exposition, May 10-15, 2003, Dallas Convention Center, Dallas, TX.
63. "Research on Reactive Chemical Hazards at the Mary Kay O'Connor Process Safety Center," paper presented at the Texas Chemical Council 2003 Safety Seminar, June 2-5, 2003, Galveston, Texas.
64. "Options with Regard to Reactive Chemical Hazard Management Systems," paper presented at the *Reactive Chemical Hazard Management Roundtable* sponsored by the U.S. Chemical Safety and Hazard Investigation Board, June 10, 2003, Washington, DC.
65. "MOC's Impact on Engineering Information Management," paper presented at the *Engineering Information Management Conference*, June 27, 2003, Houston, Texas.
66. "Predicting Properties of Energetic Materials via Molecular Modeling," paper presented at the AIChE 2003 Annual Meeting, November 16-21, 2003, San Francisco, California (presented by S.R. Saraf, graduate student).
67. "Dynamic Process Monitoring Based On Classification Tree and Discriminant Analysis," paper presented at the AIChE 2003 Annual Meeting, November 16-21, 2003, San Francisco, California (presented by Y. Zhou, graduate student).

68. "Thermal Stability of Inhibited 1,3-Butadiene in the Presence and Absence of Oxygen," paper presented at the AIChE 2003 Annual Meeting, November 16-21, 2003, San Francisco, California (presented by A.A. Aldeeb, graduate student).
69. "Adiabatic Calorimetric Analysis of Runaway Polymerization Reactions," paper presented at the AIChE 2003 Annual Meeting, November 16-21, 2003, San Francisco, California (presented by A.A. Aldeeb, graduate student).
70. "Process Safety Challenges for the Chlorine Industry," Keynote Presentation at the Chlorine Institute's 80th Annual Meeting, March 9, 2004, Houston, Texas.
71. "The Unique Role of the University-Based Centers in Meeting Process Safety Challenges," paper presented at the Texas Chemical Council, March 26, 2004, Houston, Texas.
72. "Designing and Auditing Management Systems for Safety, Health and Environmental Risks Related to Chemical Processing," paper presented at the Risk Center Roundtable, Wharton Risk Management & Decision Processes Center, University of Pennsylvania, April 22, 2004, Philadelphia, Pennsylvania.
73. "Implementation Issues With Regard to Reactive Chemicals," paper presented at Rohm and Haas Training Center, April 23, 2004, Bristol, Pennsylvania.
74. "A Systematic Approach to Reactive Chemicals Analysis," paper presented at the 3rd Annual NaTex Meeting, *Frontiers in Materials Research: Applications of Thermal Analysis and Rheology*, April 29-30, 2004, Dallas, Texas.
75. "PSM Programs in the United States: Present Status and Future Directions – A Moving Target," paper presented at the *International Seminar on Preventive Safety Management in Gas Industry*, June 24, 2004, Seoul, South Korea.
76. "Application of Accidental Release Information for the Development of Prevention, Mitigation, and Response Measures for Counterterrorism," paper presented at the 2nd Toxic Industrial Chemical (TIC) and Toxic Industrial Material (TIM) Symposium, Virginia Commonwealth University, July 20-22, 2004, Richmond, Virginia.
77. "Use of Incident Data Collection from Various Sources For Industrial Safety Performance Assessments," paper presented at the OECD Workshop on *Lessons Learned from Chemical Accidents and Incidents*, Karlskoga, Sweden, September 21-23, 2004.
78. "Hydroxylamine decomposition pathways in the presence of acid or base," paper presented at the AIChE 2004 Annual Meeting, November 7-12, 2004, Austin, Texas (presented by C. Wei, graduate student).
79. "Computational Tools to Predict Heats of Reaction and Activation Energy for Reactivity

Resume for M. Sam Mannan, PhD, PE, CSP

- Hazards Evaluation,” paper presented at the AIChE 2004 Annual Meeting, November 7-12, 2004, Austin, Texas (presented by M. Vidal, graduate student).
80. “Flash point of mixtures: Can computational chemistry help you decide?” paper presented at the AIChE 2004 Annual Meeting, November 7-12, 2004, Austin, Texas (presented by M. Vidal, graduate student).
 81. “Routing Methodology Design for Hazardous Materials Transportation: Evaluating Uncertainty by Fuzzy Logic,” paper presented at the AIChE 2004 Annual Meeting, November 7-12, 2004, Austin, Texas (presented by Y. Qiao, graduate student).
 82. “Experimental and Computational Methods for Process Safety Research,” paper presented at the 11th National Engineering Congress, Maracaibo, Venezuela, November 8-12, 2004.
 83. “Sustainability: Lip Service to Measurable Advances,” paper presented at *Science and Engineering for Sustainable Development: 2005 Annual Sigma Xi Symposium*, Texas A&M University, College Station, Texas, March 31, 2005.
 84. “Equipment Reliability and the Overall Safety of Process Plants,” paper presented at the 2005 Meridium Conference, Houston, Texas, April 12, 2005.
 85. “LNG Fire Fighting at Texas A&M: Training and Research,” paper presented at the AIChE Spring National Meeting, Topical Conference on Natural Gas Utilization, Atlanta, Georgia, April 2005.
 86. “Experience with FEM3A,” paper presented at the AIChE 2006 Spring National Meeting, April 23-27, 2006, Orlando, Florida (presented by B. Cormier, graduate student).
 87. “Learnings With Regard to Safety Culture from the Columbia Disaster,” Invited Lecture, May 11, 2006, Technical University of Łódź, Poland.
 88. “Engineering Ethics,” Invited Seminar at BP, May 30, 2006, BP Corporate Office, Houston, Texas.
 89. “Fundamentals of Safety and Loss Prevention,” Invited Seminar at Eastman Chemical, May 30–June 1, 2006, Batesville, Arkansas.
 90. “Improving Safety and Small- and Mid-Sized Facilities,” Invited Seminar at Texas Chemical Council EHS Conference, June 8, 2006, Galveston, Texas.
 91. “Safety Challenges for Alternative Energy Sources,” Invited presentation at the National Research Laboratory, Seoul, South Korea, June 22, 2006.
 92. “Incident Investigation,” Invited presentation at the 8th Annual Gas Safety Promotion and Rally, Korea Gas Safety Corporation, Seoul, South Korea, June 23, 2006.

93. "Safety and Engineering for Refinery Upgrade," Invited presentation at BP America, Inc., Houston, Texas, July 26, 2006.
94. "Hazards and Risks for Ethylene Production Processes," Invited presentation at Aker Kvaerner, Houston, Texas, July 27, 2006.
95. "Data Leads the Way," CDC NCEH/ATSDR 7th National Environmental Health Conference, Hilton Atlanta Hotel, Atlanta, Georgia, December 4-6, 2006.
96. "Reactive Chemicals and Process Plant Incidents," Invited presentation at the East China University of Science and Technology, Shanghai, China, December 15, 2006.
97. "Lessons Learned From Recent Incidents," Invited presentation at Zhejiang University, Zhejiang, China, December 18, 2006.
98. "Polymerization and Chemical Process Safety," Invited presentation at Tsinghua University, Beijing, China, December 20, 2006.
99. "Challenges for the Process Industry," Invited presentation at the Beijing University of Chemical Technology, Beijing, China, December 21, 2006.
100. "Learning From the Past: Three Incidents Provide a Wealth of Learnings," Invited presentation at the ExxonMobil Annual Engineering Conference, Marriott Intercontinental Hotel, Houston, Texas, January 23, 2007.
101. "The Use of Indicators and Metrics for Measuring Abnormal Situations and Improving Safety Performance," Invited presentation at the Abnormal Situation Management Consortium Quarterly Meeting, Atlanta, Georgia, January 24-25, 2007.
102. "Emergency Planning and Response to Process Plant Incidents," Invited presentation at the Local Emergency Planning Committee Meeting, College Station, Texas, February 15, 2007.
103. "Fire and Explosion Assessment on Oil and Gas Floating Production Storage Offloading (FPSO) : an Effective Screening and Comparison Tool," paper presented at the AIChE 2007 Spring Meeting, April 22-26, 2007, Houston, Texas (presented by J.A. Suardin, graduate student).
104. "Use of Adiabatic Calorimetry and Aging Test for Safe Storage Study of Hydroxylamine Nitrate," paper presented at the AIChE 2007 Spring Meeting, April 22-26, 2007, Houston, Texas (presented by L. Liu, graduate student).
105. "Resilient Engineered Systems: the Development and Demonstration of an Inherent System Property," paper presented at the AIChE 2007 Spring Meeting, April 22-26, 2007, Houston, Texas (presented by S.M. Mitchell, graduate student).

106. "Development of a Miniature Calorimeter for Identification and Detection of Explosives and Other Energetic Compounds," paper presented at the AIChE 2007 Spring Meeting, April 22-26, 2007, Houston, Texas (presented by Y.-S. Liu, Assistant Professor, University of Louisiana at Lafayette).
107. "Optimum Route Selection for Hazardous Materials Transportation Incorporating Security and Cost-Effectiveness Considerations," paper presented at the AIChE 2007 Spring Meeting, April 22-26, 2007, Houston, Texas (presented by Y. Qiao, DNV Inc.).
108. "High Expansion Foam Application for Controlling LNG Pool Fire -- Experiment Results and Analysis," paper presented at the AIChE 2007 Spring Meeting, April 22-26, 2007, Houston, Texas (presented by J.A. Suardin, graduate student).
109. "Bulk Temperature Profile of LNG Spill on Unconfined Water – Experiment Results and Analysis," paper presented at the AIChE 2007 Spring Meeting, April 22-26, 2007, Houston, Texas (presented by B. Cormier, graduate student).
110. "Bulk Temperature Profile of LNG Spill on Unconfined Water – Experiment Results and Analysis," paper presented at the AIChE 2007 Spring Meeting, April 22-26, 2007, Houston, Texas (presented by B. Cormier, graduate student).
111. "Chemical Safety – Update and Challenges," Keynote Speech at National Petrochemical and Refiners Association National Safety Conference, May 2, 2007, The Woodlands, Texas.
112. "Are We Safer Today," Keynote Speech at the 2007 Coking Safety Seminar, May 8, 2007, League City, Texas.
113. "Chemical Safety – The Aftermath of BP Texas City Incident," Keynote Speech at the 2007 Global Refining Strategies Summit, September 10-11, 2007, Houston, Texas.
114. "Bio-Diesel Safety Issues," Conference on Process Safety Challenges in the Biorenewables Era, Iowa State University, Ames, Iowa, March 13, 2008
115. "Globalization and its Challenges in Industrial Process Safety," Wendell Miller Distinguished Lecture, Iowa State University, Ames, Iowa, March 14, 2008
116. "A Framework for Creating a Best-in-Class Safety Culture," 2008 Oil and Gas Software Users Group Meeting, March 26, 2008, Houston, Texas.
117. "The Risk Assessment of Bayesian-LOPA Methodology for an LNG Importation Terminal," paper presented at the 2008 AIChE Spring National Meeting, 8th Topical Conference on Natural Gas Utilization, New Orleans, Louisiana, April 6-10, 2008. (presented by G. Yun, graduate student).

Resume for M. Sam Mannan, PhD, PE, CSP

118. “Comparison of LNG Computational Fluid Dynamics Consequence Modeling with Brayton Field Fire School Test Data – Preliminary Assessment,” paper presented at the 2008 AIChE Spring National Meeting, 8th Topical Conference on Natural Gas Utilization, New Orleans, Louisiana, April 6-10, 2008 (presented by B.R. Cormier, graduate student).
119. “Detection and Measurement of Fugitive Methane Gas Emission Using Infrared Imaging Camera,” paper presented at the 2008 AIChE Spring National Meeting, 8th Topical Conference on Natural Gas Utilization, New Orleans, Louisiana, April 6-10, 2008 (presented by A. Safitri, graduate student).
120. “Expansion Foam 3-D Temperature Profile during Application on LNG Experimental Results,” paper presented at the 2008 AIChE Spring National Meeting, 8th Topical Conference on Natural Gas Utilization, New Orleans, Louisiana, April 6-10, 2008 (presented by J.A. Suardin, graduate student).
121. “Alternative Fuels and Engineering for Sustainable Development,” paper presented at the 2008 AIChE Spring National Meeting, New Orleans, Louisiana, April 6-10, 2008 (presented by Y. Guo, research scientist).
122. “Effect of Availability on Multi-Period Planning of Oil and Gas Production Systems,” paper presented at the 2008 AIChE Spring National Meeting, New Orleans, Louisiana, April 6-10, 2008 (presented by K.R. Vazquez, graduate student).
123. “A Novel Approach for Predicting and Quantifying Tangible and Intangible Risks for Catastrophic Incidences in the Chemical Process Industry,” paper presented at the 2008 AIChE Spring National Meeting, New Orleans, Louisiana, April 6-10, 2008 (presented by K. Prem, graduate student).
124. Markowski, A.S. and M.S. Mannan, “fRisk Assessment in Chemical Industry,” 18th International Congress of Chemical and Process Engineering, August 24-28, 2008, Prague, Czech Republic.
125. Medina, A.F., M.S. Mannan, H.H. West, W.J. Rogers, R.J. Solano and C. Aiello, “Initiation and Mechanism of Carbon Filter Fires,” 18th International Congress of Chemical and Process Engineering, August 24-28, 2008, Prague, Czech Republic.
126. Mannan, M.S., S.A. Ashfaq and Y. Guo, “Engineering for Sustainable Development and its Application to Fuel Cell Systems,” 18th International Congress of Chemical and Process Engineering, August 24-28, 2008, Prague, Czech Republic.
127. Mannan, M.S., “A Technical Analysis of the Buncefield Explosion and Fire,” Invited Keynote Presentation, International Process Safety Symposium, Technical University of Lodz, Poland, December 12, 2008.

Resume for M. Sam Mannan, PhD, PE, CSP

128. Mannan, M.S., "Sustainability in Chemical Engineering," Invited Keynote Speech, 2009 Auditing Roundtable National Meeting, April 21-23, 2009, San Antonio, Texas.
129. Mannan, M.S., "Recent Advances in LNG Field Experiments and Modeling of LNG Release and Mitigation Scenarios," Invited Keynote Speech, 9th Topical Conference on Natural Gas Utilization, AIChE Spring 2009 National Meeting, April 29, 2009, Tampa, Florida.
130. Rana, M.A. and M. S. Mannan, "Water Curtain Application for Forced Dispersion of LNG Vapor," 9th Topical Conference on Natural Gas Utilization, 2009 AIChE Spring National Meeting, Tampa, Florida, April 26-30, 2009 (presented by M. Rana, graduate student).
131. Yun, G., Y. Guo and M. S. Mannan, "Study on the Heat Transfer of Expansion Foam on LNG Pool," 9th Topical Conference on Natural Gas Utilization, 2009 AIChE Spring National Meeting, Tampa, Florida, April 26-30, 2009 (presented by G. Yun, graduate student).
132. Qi, R., D. Ng, W.J. Rogers and M. S. Mannan, "LNG Vapor Dispersion Modeling with ANSYS CFX," 9th Topical Conference on Natural Gas Utilization, 2009 AIChE Spring National Meeting, Tampa, Florida, April 26-30, 2009.
133. Wang, Q., D. Ng and M.S. Mannan, "Will a Molecular Simulation Approach Help You Predict Thermodynamic Properties?" 2009 AIChE Spring National Meeting, Tampa, Florida, April 26-30, 2009.
134. Mannan, M.S., "Making the Right Decision,: What We Learn From our History," 38th Annual Iowa Governor's Safety and Health Conference, Cedar Rapids Marriott, Cedar Rapids, Iowa, November 4-5, 2009.
135. Mannan, M.S., "Lessons Learned from Past Incidents Shed Light on Present Day Needs and Challenges in Process Safety," Distinguished Lecture Series, Texas A&M University at Qatar, Doha, Qatar, January 26, 2010.
136. Mannan, M.S., "Development of the Effective Metrics for Measuring Improvements in Safety Performance," Plenary Keynote Lecture, The 3rd Doha Engineering and Technology Forum at Texas A&M University at Qatar and the 1st Texas A&M at Qatar Safety Symposium, Doha, Qatar, March 15-16, 2010.
137. Yun, G., D. Ng and M. S. Mannan, "A medium-scale field test on expansion foam application – key findings of LNG pool fire suppression on land," 10th Topical Conference on Natural Gas Utilization, 2010 AIChE Spring National Meeting, San Antonio, Texas, March 21-25, 2010 (presented by G. Yun, graduate student).
138. Qi, R., D. Ng, S.P. Waldram and M. S. Mannan, "Uncertainties in Modeling LNG Vapor Dispersion with CFD Codes," Professor Cedomir M. Sliepcevich Memorial

Session, 10th Topical Conference on Natural Gas Utilization, 2010 AIChE Spring National Meeting, San Antonio, Texas, March 21-25, 2010 (presented by R. Qi, graduate student).

139. Patel, S., D. Ng and M. S. Mannan, "Integrating Safety Issues in Solvent Selection and Process Design," 2010 AIChE Spring National Meeting, San Antonio, Texas, March 21-25, 2010 (presented by S. Patel, graduate student).
140. Jung, S., D. Ng, C. Laird and M. S. Mannan, "A New Approach to Optimizing Facility Layout by Mapping Risk On Grids," 2010 AIChE Spring National Meeting, San Antonio, Texas, March 21-25, 2010 (presented by S. Jung, graduate student).
141. Wang, Q., B.F. Bennighof, J.A. Suardin, N.R. Popat, J. McPhate and M. S. Mannan, "RIV and SSIV Installations On Deepwater Platforms: A Decision Making Screening Tool," 2010 AIChE Spring National Meeting, San Antonio, Texas, March 21-25, 2010 (presented by Q. Wang, graduate student).
142. Yang, X., C.D. Laird and M. S. Mannan, "Pareto Optimization On Component Inspection Interval for Level Control in An Oil/ Gas Separation System," 2010 AIChE Spring National Meeting, San Antonio, Texas, March 21-25, 2010 (presented by X. Yang, graduate student).
143. Mannan, M.S., "How Can Academia and the Safety Industry Support Each Other," American Society of Safety Engineers Annual Conference, Baltimore, Maryland, June 13-16, 2010.
144. Mannan, M.S., "Globalization and its Challenges in Industrial Process Safety," Invited Keynote Speech, The 3rd World Conference on Safety of Oil and Gas Industry, WCOGI 2010, September 27-28, 2010, Beijing, China.
145. Mannan, M.S., "Adapting Downstream Guidelines and Methodologies to Upstream Facilities," Invited Keynote Speech, 2010 Siemens Users Forum, October 14, 2010, Houston, Texas.
146. Mannan, M.S., "Consequence Analysis & Inherently Safer Design," Invited two-day presentation, The Society of Loss prevention in the Process Industries, December 6-7, 2010, Singapore.
147. Mannan, M.S., "The Relationship of Safety and Risk Management to Engineering for Sustainable Development," Invited Keynote Speech, Bangladesh University of Engineering and Technology (BUET), December 9, 2010, Dhaka, Bangladesh.
148. Mannan, M.S. and H.J. Pasman, "Fundamentals of Process Safety and Risk Management," Invited two-day presentation, Bangladesh University of Engineering and Technology (BUET), December 9-10, 2010, Dhaka, Bangladesh.

149. Mannan, M.S., and H. Pisman, "Layer of Protection Analysis," Invited two-day presentation, Chola mandalam MS Risk Services, December 14-15, 2010, Chennai, India.
150. Mannan, M.S., "Global Concerns About Energy Security and Safety" Invited two-day presentation, Rajiv Gandhi Institute of Petroleum Technology, December 16-17, 2010, Mumbai, India.

BIOGRAPHICAL INFORMATION

Dr. M. Sam Mannan has 32 years of wide-ranging experience covering process design of chemical plants and refineries, computer simulation of engineering problems, mathematical modeling, and process safety and risk assessment in the chemical process industries. Dr. Mannan is Professor in the Chemical Engineering Department at Texas A&M University and Director of the Mary Kay O'Connor Process Safety Center at the Texas Engineering Experiment Station. The mission of the Center is to improve safety in the chemical process industry by conducting programs and research activities that promote safety as second nature for all plant personnel in their day-to-day activities. Before joining Texas A&M University, Dr. Mannan was Vice President at RMT, Inc., a nationwide engineering services company.

Dr. Mannan is a registered professional engineer in the states of Texas and Louisiana, is certified by the National Council of Examiners for Engineers and Surveyors, and is a Certified Safety Professional. His experience is wide ranging, covering process design of chemical plants and refineries, computer simulation of engineering problems, mathematical modeling, process safety, risk assessment, inherently safer design, critical infrastructure vulnerability assessment, aerosol modeling, and reactive and energetic materials assessments.

Dr. Mannan is involved very closely with projects that include hazard assessment and risk analysis, process hazard identification, HAZOP (hazard and operability) studies, vulnerability assessment, process safety management, and risk management. His research interests include development of inherently safer processes, application of computational fluid dynamics to study the explosive characteristics of flammable gases, development of quantitative methods to determine incompatibility among various chemicals, application of calorimetric methods for the assessment of reactive hazards, and the application of consequence analyses to assess the impact of process plant incidents. He co-authored the *Guidelines for Safe Process Operations and Maintenance* published by the Center for Chemical Process Safety, American Institute of Chemical Engineers. He is the editor of the 3rd edition of the 3-volume, 3,680-page, authoritative reference for process safety and loss prevention, "Lees' Loss Prevention in the Process Industries." Dr. Mannan has over 100 peer-reviewed publications and over 115 proceedings papers.

Dr. Mannan is the recipient of numerous awards and recognitions including the American Institute of Chemical Engineers *Service to Society Award*, the Texas A&M University

Association of Former Students' *Distinguished Achievement Award for Teaching*, the Texas Engineering Experiment Station *Research Fellow*, the Texas A&M University Dwight Look College of Engineering *George Armistead, Jr. '23 Fellow*. In 2003, Dr. Mannan served as a *consultant to Columbia Accident Investigation Board*. In 2006, he was named the inaugural holder of the T. Michael O'Connor Chair I. In 2007, he was elected Fellow of the American Institute of Chemical Engineers. In December 2008, the Board of Regents of Texas A&M University System recognized Dr. Mannan's contributions in teaching, research and service by naming him Regents Professor of Chemical Engineering. The Texas A&M System Board of Regents established the Regents Professor Award program in 1996 to recognize employees who have made exemplary contributions to their university or agency and to the people of Texas. To date, 105 faculty members have been named Regents Professors.

Dr. Mannan received his B.S. in chemical engineering from the Engineering University in Dhaka, Bangladesh in 1978, and obtained his M.S. in 1983 and Ph.D. in 1986 in Chemical Engineering from the University of Oklahoma.

KEY PROJECTS

Confidential - Consequence Analysis for Litigation Support (Canada). March, 1991 to March, 1993.

Project Manager: The consequence analysis was performed for a major refinery fire. A refinery fire had resulted in extensive damages to the refinery. The objective of the consequence analysis was to determine if the extent of damage would have been any different if the design of the plant had been different. Using computer models of hazard assessment (e.g., vapor generation and dispersion, fires, and explosion), the base case for the refinery fire was established. Perturbations were then made to the design configuration and plant layout and the hazard assessment model was rerun to determine the extent of the damages. The consequence analysis project provided critical evidence with regard to settlement of litigation claims.

OXY USA, Inc. - Disaster Review Modeling - (Myrtle Springs, Texas). July, 1990 to May, 1991.

Project Manager: The gas company was planning the installation of a compressor to transfer sour natural gas from its gathering fields to its processing facility. The disaster review modeling (required by TACB/TNRCC regulations) was performed to determine the worst-case accident and release scenario. This information was then used to determine off-property ground-level concentrations and the impacted areas.

Coastal Eagle Point Oil Company - Dispersion Modeling for Off-Site Impact Assessment - (Westville, New Jersey). October, 1993 to December 1993.

Project Manager: State regulations required the refinery to conduct a worst-case release analysis for power failure. The refinery had multiple relief valves on different units in the plant. The fluid streams inside the units had varying concentrations of hydrogen sulfide. The state regulatory agency required the refinery to submit a report showing off-property

concentrations of hydrogen sulfide resulting from simultaneous releases from all the relief valves because of a total power failure. We used our dense gas hazard assessment model to simulate the postulated worst-case scenario and develop impact contours for downwind dispersion distances.

Calcasieu Refining Company - Emergency Response Plan (Lake Charles, Louisiana). January, 1993 to June, 1993.

Project Manager: The emergency response plan (ERP) was developed for a crude oil topping plant in Louisiana. The ERP was prepared in accordance with 29 CFR 1910.119(n) and 29 CFR 1910.38(a) and covers such issues as plant emergency coordination, risk evaluation, notification procedures, communication systems, emergency equipment, training and procedures to return to normal operations. The plan defines responses to emergency releases and/or explosions, both small and large. The worst-case scenario and risk analysis was used as the basis of the ERP.

American Institute of Chemical Engineers - Guidelines for Safe Process Operations and Maintenance (New York, New York). March, 1992 to March 1995.

Lead Author: The Center for Chemical Process Safety (CCPS) was established in 1985 by the American Institute of Chemical Engineers to develop and disseminate technical information for use in the prevention of major chemical accidents. The "Guidelines for Safe Process Operations and Maintenance" is part of a series of guideline documents published by the CCPS to reduce the risk of catastrophic incidents in the process industries. The Guidelines is intended for plant personnel who must execute site safety programs, policies, and procedures during the life cycle of a plant. The primary target audience includes all operations and maintenance personnel who have first-and second-line supervision in maintaining the process and equipment integrity of the plant throughout the life cycle of the plant. The cycle starts from initial design, and continues through construction, pre-startup and commissioning, startup, operation, maintenance, shutdown, and decommissioning/demolition.

OXY USA, Inc. - Hazard Assessment - (East Texas). May, 1990 to August, 1991.

Engineer: The gas processing company was planning various modifications and expansions in a gas plant. In addition, the company was also planning to decommission various equipment and facilities at another plant. The objective of the hazard assessment was to identify possible hazards, which may result from the proposed changes. As a result of the assessment, recommendations were made to enhance safety in the operation and maintenance activities of the plants.

City of Austin - Hazardous Materials Water Contamination Risk Study (Austin, Texas). July, 1993 to April, 1994.

Project Manager: The objective of the risk study performed for the City of Austin was to assess the risk of accidental water contamination from catastrophic releases of toxic and hazardous materials to the different water bodies within the city and the extraterritorial jurisdiction (ETJ) of Austin. Potential sources of releases included approximately 1,800 different companies which reported storage of over 7,000 containers of hazardous or toxic materials. Hazard scenarios were identified by establishing exposure pathways for known

surrounding features (man-made or natural) between the released liquid and the water body of concern. The results from the risk assessment included an assessment of the relative risk which the sites pose for accidental water contamination from catastrophic releases of hazardous and toxic materials and identification of measures that the City can take to reduce the risks of accidental contamination. In addition, transportation routes were analyzed for sensitivity to potential water contamination from spills of toxic and hazardous materials.

LaRoche Chemicals, Hazop Study for Ammonia Storage System, (Baton Rouge, Louisiana). January, 1993 to March 1993.

Project Manager: This project was performed for a fertilizer company's ammonia storage system at the Baton Rouge facility to comply with the OSHA Process Safety Management regulations (29 CFR 1910.119). A team of appropriately qualified personnel was constituted for conducting this process hazards analysis. The Hazard and Operability (HAZOP) study methodology was selected to perform the analysis on the ammonia storage tank, repulper tanks and the associated piping and equipment. As a result of this study, a total of twenty-two recommendations were suggested by the team to either reduce the likelihood of occurrence or lower the consequence resulting from an identified scenario.

Confidential Client, Health and Safety Audit, (Freeport, Texas). June, 1991 to December 1991.

Project Manager: This project was performed for a mid-size chemical plant to determine compliance with Occupational Safety and Health Administration regulations affecting the health and safety of employees in the plant. The project was performed under attorney/client privilege. The objective of the project was to determine compliance with OSHA health and safety regulations. The project resulted in a health and safety audit report and a health and safety manual. The health and safety manual was developed for use in conjunction with safety standards, policies, and procedures within the company. During the project, all applicable regulatory standards and recommended industry practices were analyzed with regard to impact on operations of the plant. The resulting manual was later used for training of field personnel and first-line supervisors.

Calcasieu Refining Company, Operating Procedures, (Lake Charles, Louisiana). March, 1993 to May, 1993.

Project Manager: A standard operating procedures manual was prepared for the refinery in Lake Charles, Louisiana. The development and implementation of written operating procedures are required under the OSHA Process Safety management regulations (29 CFR 1910.119). The objective of the operating procedures is to provide clear operating instructions for safely conducting processing activities in the crude oil topping plant. The resulting manual is also used for training of the plant personnel. It covers steps for each operating phase; operating limits; and safety systems and their functions.

Calcasieu Refining Company, PSM Compliance Assessment, (Lake Charles, Louisiana). June, 1992 to August, 1992.

Project Manager: This project was performed for the refinery to determine compliance with the OSHA Process Safety Management regulations (29 CFR 1910.119). The compliance assessment was designed to identify documentation and procedures in place and

determined whether this fulfilled the requirements of the OSHA PSM regulations. More importantly, the assessment also identified any additional procedures or documentation needed to fully comply with the regulation. From the assessment, a plan and schedule was developed that included a work plan addressing the manpower needed for compliance. The plan was used as an effective management tool with regard to budget allocation and decisions for manpower scheduling.

OXY USA, Inc., Risk Assessment, (East Texas). June, 1990 to November, 1991.

Engineer: The company was planning the construction of a sour gas gathering line for transferring sour gas from its producing fields to its processing facilities. The objective of the risk analysis before construction of the pipeline was aimed at (1) determining problem areas regarding design, construction, operation and maintenance of sour gas pipelines which may contribute to pipeline failure; (2) suggesting measures and techniques for detecting pipeline failures and reducing the impact of such failures; (3) assuring compliance with governmental regulations; and (4) suggesting methods to build redundancies into the system to facilitate safe operation and maintenance. The work from this project was used as the basis of an article published in the Oil and Gas Journal.

Champlin Refining and Chemicals, Inc., Safety Engineering for High Pressure LPG Storage, (Corpus Christi, TX). January, 1991 to December, 1991.

Engineer: The refinery was planning the construction of two large spherical storage vessels for storing liquefied petroleum gas (LPG). The objective of the safety engineering study was to (1) provide our recommendation on the selection of a site between two available sites; (2) determine potential hazard scenarios from the operation and maintenance of the storage vessels at the selected site; (3) determine consequences of potential hazard scenarios and the impact of these consequences on the surrounding area and the public; (4) provide recommendations for changes in design and construction to improve safety of the storage vessels, and (5) provide recommendations to improve safety during operation and maintenance of the storage vessels.

Vista Chemical Company, PSM Audit Program, (Houston, Texas). November, 1993 to date.

Project Manager: The objective of this project was the development and implementation of a corporate program for Process Safety management (PSM) Compliance Auditing and an associated Training Program for training Vista personnel for auditing Vista's facilities for compliance with the OSHA PSM rule as described in 29 CFR 1910.119. The project effort was focused towards providing the staff of Vista the tools and training with which: 1) they can efficiently perform audits of the PSM programs being implemented at each of the company's five facilities; and 2) Vista management can gauge the overall effectiveness of the implementation efforts now in progress at the facilities to meet the requirements of the OSHA PSM rule.

Vista Chemical Company, Baltimore Plant Revamping, (Baltimore, Maryland). March, 1994 to February 1995.

Project Manager: A major revamping project for the Baltimore plant was necessitated by business reasons. The revamping is needed because of a change in technology precipitated

by market demands. The revamped plant will continue to produce detergent alkylate. However, instead of the earlier process, Vista has decided to use the UOP process to make olefins and then make detergent alkylate. The objective of the project was to provide Vista with PSM support services during the design, construction, and installation of the revamping project. The intent was to: ensure that the design, construction, and installation of equipment follow the requirements of the PSM rule; ensure the development of the data, process information, and procedures that will be needed for compliance with the PSM rule; and provide for a smooth transition of the PSM program from the design, construction, and installation phases to operation.

J.R. Simplot Company, PSM Tracking Database (Pocatello, Idaho). May 1994 - April 1995.

Project Manager: The PSM rule requires covered facilities to develop, implement and practice a 14-element program. The implementation and practice of many of these elements, including process hazard analysis, management of change, incident investigation and compliance audits, results in hazard management and risk reduction recommendations. This project was undertaken in response to a client request to develop a computerized system for the fertilizer manufacturer to do tracking, recordkeeping and documentation. The objectives are to compile the recommendations from various PSM activities, to update and maintain any related information, and to produce specific reports for documentation as needed. This customized program was developed using Microsoft's FoxPro® software to meet specific tracking expectations and employee access requirements.

J.R. Simplot Company, Mechanical Integrity program (Pocatello, Idaho). January 1994 - March 1996.

Project Manager: Engineering, fabrication, inspection and test, and maintenance of applicable chemical processes and equipment are now regulated plant activities by OSHA's 29 CFR 1910.119 and EPA's 40 CFR 68. The regulations require equipment to be designed, operated, and maintained in accordance with good engineering practice, manufacturers recommendations, and plant history. The regulatory requirements are performance-based, or results-oriented, requiring the plant to develop its specific equipment design basis and mechanical integrity programs. This project involved the formidable task of developing and implementing mechanical integrity programs for plant equipment with little or no existing design basis documentation. Key programs that were implemented include identification of critical equipment, inspection and test planning, good engineering practice, corrective action policies, training, and procedure development.

Ameripol Synpol Corporation, Relief Valve Design and Design Basis Study (Beaumont, Texas). May 1995 – June 1997

Project Manager: This project was performed for a synthetic rubber production plant including the storage facilities to comply with the OSHA Process Safety Management regulations (29 CFR 1910.119). As part of the Process Safety Information requirements of the regulation, relief device design and design basis must be maintained and updated. A study was conducted to ensure and compile the proper relief valve design data needed to comply with the regulation. As a result of this study, relief valve design calculations were done and recommendations for modifications and operating procedures for the relief device

system were made. The study resulted in a report which included: a) the standards and design basis used for sizing the relief valves for the PSM-covered process, b) the recommendations that resulted from the study, c) a list of relief valves that were undersized for the intended applications, and d) a calculation and sizing sheet for each of the relief valves. As needed, DIERS technology was applied for the relief valve sizing calculations.

Ashland Chemical Company, Corporate Risk Management Program Implementation (Columbus, Ohio). January 1996 – December 1999

Project Manager: EPA's risk management program rule requires regulated facilities to develop and implement appropriate risk management programs to minimize the frequency and severity of chemical plant accidents. The risk management program rule has three main components. They are hazard assessment, prevention program, and emergency response program. The rule also requires regulated facilities to develop a Risk Management Plan (RMP). The RMP includes a description of the hazard assessment, prevention program, and the emergency response program. The project involved the development of an implementation plan to bring all the Ashland facilities into compliance. This included development of guidance documents, training of appropriate personnel, completion of modeling, improvement and revision of prevention programs and emergency response programs, and development of format and content for risk communication, and public meetings for risk communication.

Brazoria County Petrochemical Council, Risk Management/Risk Communication program (Freeport, Texas). June 1996 - December 1998

Project Manager: The 13 petrochemical companies of Freeport, Texas joined together in an effort aimed at complying with EPA's Risk Management Program. The companies working together in this project are Air Liquide America, Amoco Chemicals, BASF Corporation, Dow Chemical Company, Gulf Chemical and Metallurgical Corporation, Nalco/Exxon Energy Chemicals, Phillips Petroleum Company, Rhone-Poulenc, Roche Company, Schenectady International, and Shintech. The objective of this project is to develop homogeneous programs for compliance with the various requirements of EPA's risk management program. After completion of the risk management plans, the companies expect to communicate the plans to the public in town hall meetings or other such suitable format.

Expert Panel on Quantitative Risk Assessment for the Anniston Chemical Agent Disposal Facility (ANCDF) and the Umatilla Chemical Agent Disposal Facility (UMCDF). January 1998 – July 2001.

Expert Panel Member: To help manage the risk during the construction, operation, and maintenance of the ANCDF and the UMCDF, SAIC conducted detailed quantitative risk assessments. Expert panels were constituted to review and critique the risk assessment methodology and the resulting reports. As an expert panel member, we met periodically with the SAIC project team to review progress and provide input to the project team. We also visited the ANCDF and UMCDF sites to evaluate, a) site-specific conditions and the use of site-specific information, and b) the application of the quantitative risk assessment in the risk management process.

Parsons, Quantitative Risk Assessment for Chemical Demilitarization Process - Phase I and Phase II, 1/01/00-12/31/01

Principal Investigator: A quantitative risk analysis was conducted to evaluate the design of the VX neutralization subsystem and related support facility of the Newport Chemical Agent Disposal Facility. Three major accidents including agent release, personnel injury, and system loss were studied using fault tree analysis methodology. Each incident was assigned Risk Assessment Codes by the severity level and the occurrence probability of the accidents. Safety mitigations or design changes were recommended to bring the “undesired” risk level (typical agent release events) to be “acceptable with controls” or “acceptable”.

Ashland, Inc., Reactive Chemicals Analysis of Hydroxylamine Compounds, 1/01/01-12/31/01

Principal Investigator: This project involved the measurement of calorimetric data for hydroxylamine and hydroxylamine compounds. Two calorimeters were used for studying thermal behavior of reactive systems. One is a Reactive Systems Screening Tool (RSST), which is designed for rapid measurement of thermal behavior of small samples (10 cm³) for temperatures up to 400°C and pressures to 500 psia. The second apparatus is an Automatic Pressure Tracking Adiabatic Calorimeter (APTAC) for detailed analyses of thermal behavior of larger samples (up to ~ 130 cm³) for temperatures up to 450°C and pressures up to 2,000 psia. In this calorimeter, closed-cell sample pressures are continuously matched by an external pressure of nitrogen so that sample cells of low mass and therefore low thermal inertia can be used for highly sensitive measurements of sample thermal behavior. Other advanced features of the APTAC include *in situ* additions to the sample cell of reactants or catalysts with a high-pressure syringe pump.

US Environmental Protection Agency, Chemical Safety Program Assessment Project, 7/01/01-6/30/03

Principal Investigator: The project on chemical safety program assessment includes four phases:

- | | |
|------------|--|
| Phase I: | Describe the evolution of chemical safety |
| Phase II: | Describe stakeholders' goals and objectives for improving chemical safety |
| Phase III: | Develop indicators, measures, and metrics to measure progress towards goals and objectives |
| Phase IV: | Develop report |

The objective of the project was to develop a methodology for chemical safety program assessment and to apply the methodology in an analysis of the impact of various programs for prevention of accidental releases of reactive, flammable and toxic chemicals from stationary sources. The programs evaluated include those required by regulatory authorities (e.g., OSHA, EPA) and industry standards (e.g., API, CMA). The phased approach establishes different segments of the program, each of which allows an opportunity to stop and reflect on how and whether or not to proceed.

**US Environmental Protection Agency, National Chemical Safety Data System,
7/01/01-6/30/03**

Principal Investigator: This project involves the development of a national data system in the area of chemical safety and chemical accidents. This database is a critical beginning element in a national initiative to identify national chemical safety goals, implement activities to reach the goals, and establish a measurement system to measure progress towards the goals. Current data collected at the national level through different sources do not provide sufficient information to be useful in the establishment of baseline and measurement systems. Without this essential measurement tool, movement toward the accomplishment of national chemical safety goals will not be captured. The proposed data system will utilize, where appropriate, existing data sources, and collect and analyze data of near-misses and incidents which can be related to actual causes to aid in the establishment of chemical safety baselines. With the database in place, the nation can move towards the establishment of metrics and targeted reduction goals for chemical safety incidents.

**Texas Higher Education Coordinating Board, Behavior of Heat Exchange Fluid
Aerosols Leaking from Manufacturing Processes, 1/1/99-12/31/2002**

Principal Investigator: Heat transfer fluids are widely used in industry, but conditions for safe fluid operations are not well understood and aerosols have caused costly explosions and fires. The primary goal of this research is to study the formation and dispersion of aerosols that form because of escape of heat transfer fluids through leak structures in industry. This research includes study of a variety of heat exchange fluids with a nonintrusive laser method based on the Malvern Instrument Diffraction Particle Analyzer to measure droplet sizes, spatial distributions, and concentrations forming from nozzles of various shapes to simulate leaks in pipes and vessels. The goal is to improve industrial process safety and economic practices through an understanding of how aerosols can form and strategies for safe handling of leaking fluids.

**Propane Education and Research Council, Propane Industry Incident Data
Collection - Propane Education and Research Council, 1/1/02 – 3/31/03**

Principal Investigator: This project involves the implementation of a system to collect and report incidents involving propane consistent with the overall mission to promote the safe handling and use of odorized propane in the United States. The incident data will be applied in improvement of the following areas: research and development, safety and training, consumer education, and agricultural.

**Expert Panel on Airborne Release Fractions – Department of Energy. June 2002 –
December 2002.**

Panel Member: Airborne release fractions (ARFs) are the coefficients used to estimate the amount of material suspended in air as aerosols following an accident (e.g., fire, spill, earthquake). These ARFs are used in both facility hazard categorization and detailed accident analysis to estimate accident dose consequences for DOE nuclear facilities. Existing DOE standards do not currently address several material forms of interest to the EM Program (e.g., containerized wastes, fixed matrix forms such as concrete, and

contaminated soils). DOE-EM attempted to define five alternate ARFs for materials of interest in the 1995-1996 time frame. This technical effort was never finalized and published, although it was documented in multiple versions of a draft, DOE Standard (SAFT-0029). Some DOE-EM sites have been, and are currently, utilizing SAFT-0029's draft values in certain facility hazard categorization and accident analyses.

Consultant to Columbia Accident Investigation Board. April 2003 – December 2003.

Analyze NASA's safety management and programs, decision-making processes, and safety culture. In addition, also reviewed risk analysis and risk management in addition to accident investigation models, safety culture, metrics, indicators, and decision-making processes. The analysis led to several conclusions and recommendations: The safety requirements for space flight are quite demanding and require a multi-layered approach. In the first layer, one must build in the technology and procedures that provide an appropriate level of safety for manned spacecraft. The second layer consists of management systems that ensure that procedures are followed and proper standards are implemented at all times. Finally, the third layer consists of creating a healthy and strong safety culture. The increasingly higher levels are harder to define and implement but they are very important. In fact, safety culture is very elusive and varies according to the activity and the mission of the organization.

Peer Review Panel, Hazardous Substances Emergency Events Surveillance System, Agency for Toxic Substances and Disease Registry, Centers for Disease Control, Department of Health and Human Services. July 2004 – December 2004.

Panel Member: In 2004, 16 state health departments had cooperative agreements with ATSDR to participate in the Hazardous Substances Emergency Events Surveillance System (HSEES). The state health departments report an "event" if it meets the HSEES definition, which is "any release(s) or threatened release(s) of at least one hazardous substance." A substance is considered hazardous if it might reasonably be expected to cause adverse human health effects. Releases of petroleum products are excluded from this system. Data are entered by participating state health departments into a Web-based application that enables ATSDR to access the data instantly for analysis. The public does not have access to the data; ATSDR provides summary reports of the data. The peer review panel was asked to perform a review of the HSEES system to include reviewing program accomplishments, quality of science, impact and directions, and make recommendations on improvements and modifications.

National Academy of Science, Committee on Mustard Processing at Tooele Chemical Agent Disposal Facility, 2004-2005.

Committee Member: The National Academy of Science established an ad-hoc committee to assess the technical adequacy of the proposal by the systems contractor for the Tooele Chemical Agent Disposal Facility (TOCDF) to dispose of the mustard agent stockpile stored at the adjacent Deseret Chemical Depot (DCD). The objectives of the report:

- Examine the process designs used for metal emissions removal to ensure that the selected technologies are adequate to minimize and control metal emissions, and that emissions

Resume for M. Sam Mannan, PhD, PE, CSP

will be within all applicable environmental regulations and requirements.

- Examine non-incineration treatment process designs for mercury contaminated liquid and solid mustard agent and assess the adequacy of the process design to destroy the mustard agent
- Assess the adequacy of processes for mustard agent hydrolysate disposal
- Assess the robustness of the selected process designs for their adequacy to support continuous disposal operations over the requisite duration.